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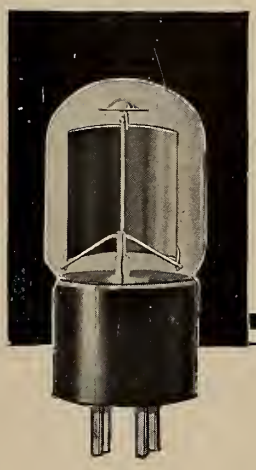
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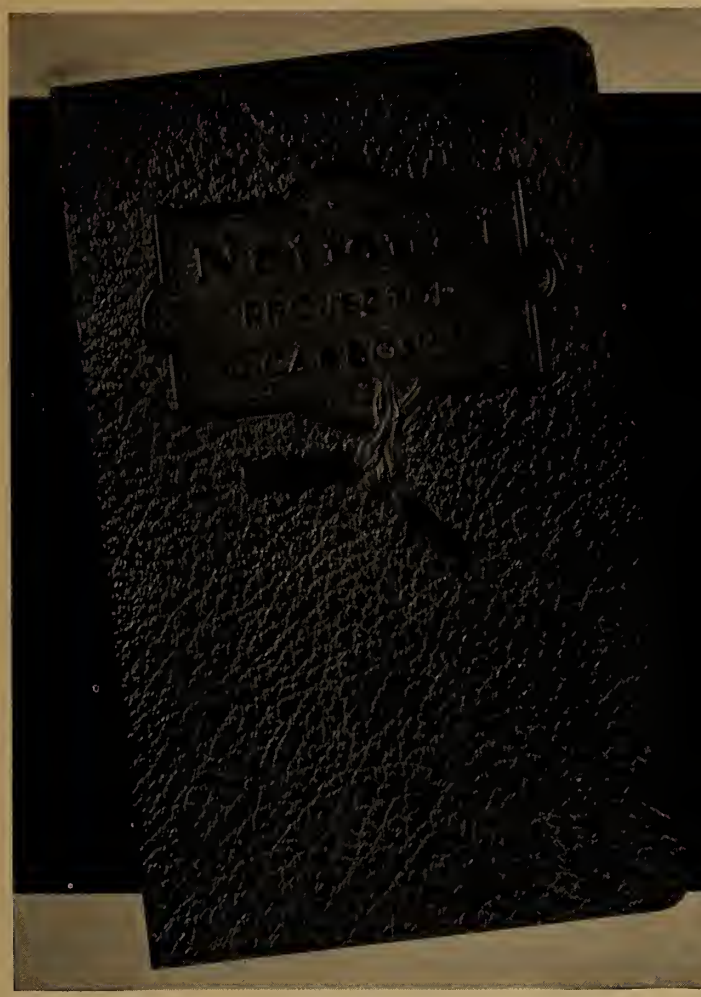
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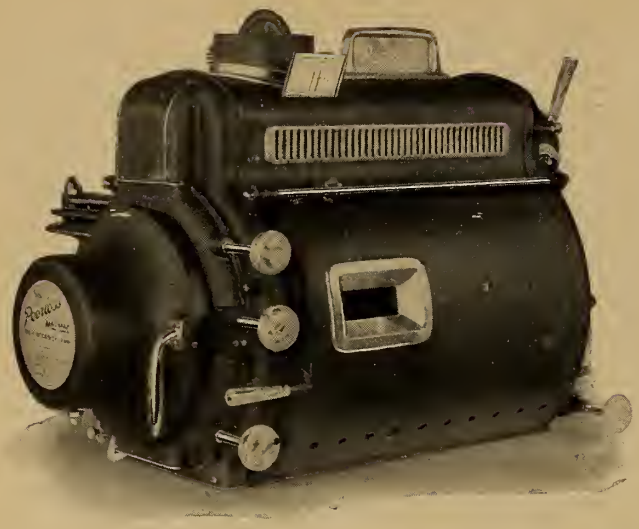
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Edited by James J. Finn

Volume 10 JANUARY 1936 *Number 1*

Index and Monthly Chat 5

Television and the Motion Picture Theatre 7
DR. A. N. GOLDSMITH

Double Reel Deferred; I. A. Opposition, Equipment Trouble Seen as Factors 11

Servicing Theatre Sound Picture Reproducing Equipment 12
C. C. AIKEN

Questions and Answers on Motor Generators 14
JOHN HERTNER

Step-By-Step Analysis of Sound Reproducing Equipment, XVIII 16
AARON NADELL

Letters to the Editor 19

Roxy's Death Recalls His Aid to the Art and Craft 20

The Editorial Page 21

Manufacturers Endorse I. P. Stand on Equipment Data .. 22
JAMES J. FINN

Craft vs. Industrial Unionism Looms as Titanic Labor Battle 23
JAMES J. FINN

Notes From the Supply Field.. 24

News Notes

Technical Hints

Miscellaneous Items

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MONTHLY CHAT

FRONT-PAGE newspapers report that RCA would market immediately home television sets costing $200 and would begin broadcasting programs within a 25-mile radius of N. Y. City unloosed another batch of frantic requests for information anent the imminence of the death of motion picture theatres. That the aforementioned reports were promptly denied by RCA officials is quite beside the point of this item, which is that I. P. has carried more than enough reliable television data to soothe the fears of even the most excitable projectionist.

For the benefit of those who persist in going off the handle at the mere mention of the word "television," we present again herein the reasoned analysis of the present status of television by Dr. A. N. Goldsmith, than whom there is no more expert televisioner. Careful attention to this basic contribution to the literature of the art is practically obligatory for all progressive projectionists.

INTRODUCTION of the new double-reel standard (not less than 1,750 feet of film mounted on one reel) has again been postponed, this time from April to August 1, this year. Since only Universal, of the major distributors, opposed the longer reel, it may be that the opposition of the organized craft occasioned this sudden setback. We shall see what we shall see.

LAST month in this corner we commented upon the fact that manufacturers were selling tons of new lamps on which neither they nor the dealers made a dime profit. This is a very unhealthy situation for all concerned, even for the theatres which alone are profiting now. Unless something happens shortly to change this pattern, I. P. will necessarily have to make an issue of this matter and, probably, make public some rather severe truths.

Profitless operation is an unhealthy situation for any manufacturer of motion picture equipment—for more reasons than that the future welfare and technological progress of the art depends largely upon the manufacturers' ability to ever press onward to new and better things. Once this development work is neglected, the art is dead.

I. P.'s CAMPAIGN for explicit instructions and complete operating data on every bit of equipment that goes into a projection room has been extremely successful—thanks to the backing given to the drive by the craft. This is just another indication of the great good that may be accomplished by a live organ of expression having the support of progressive and alert craftsmen.

As little as five years ago projectionist insistence upon complete equipment data would have evoked only laughter on the part of some manufacturers. Times do change—as do manufacturers.



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INTERNATIONAL PROJECTIONIST

VOLUME X NUMBER 1

JANUARY 1936

★ **This paper is the first basic contribution to the literature of the art of television and promises to be of historical importance. First published in I. P. for May, 1935, it is reprinted herein for the benefit of countless projectionists who have displayed of late an inordinate fear of the imminent passing of the motion picture theatre as a result of the arrival of television.**

Television and the Motion Picture Theatre

By DR. A. N. GOLDSMITH

PAST-PRESIDENT, SOCIETY OF MOTION PICTURE ENGINEERS
PAST-PRESIDENT, INSTITUTE OF RADIO ENGINEERS

IT MUST be admitted that the relationship between motion pictures and television has, in the past few years, been made the subject of numerous effusions which, even from a charitable viewpoint, must be characterized as highly imaginative and distinctly misleading. It is unfortunate that the present and future correlation of these important fields should have been made the subject of casual publicity releases or of selfishly inspired propaganda.

The subject is of considerable importance and merits thoughtful and impartial analysis. Such analysis requires, it is apparent, an unusually complete knowledge of the commercial activities and engineering methods of the two fields which are involved, and perhaps something of a gift of prophecy as well. It is proposed in the following analysis:

(*a*) to consider the methods likely to be used in television-telephone broadcasting into the home:

(*b*) to compare the results likely to be achieved by television-telephone broadcasts into the home with those obtainable by theatrical sound motion pictures;

(*c*) to consider the probable points of contacts between these fields, and to explore the possibilities of cooperative effort between them; and

(*d*) to consider the possible general effects of the widespread acceptance of television-telephone broadcasting into the home on the motion picture theatre.

A Definition of Terms

In studying (*a*), the first of these topics, it is necessary to adopt some standard for "television"—a term having widely different meanings to various people. It is proposed to accept "standards" which represent what may reasonably be expected to be attained on a large scale within the next few years, provided mass production of equipment for television-telephone broadcasting reception in the home is carried out.

The term "television-telephone broadcasting" is used because it is naturally assumed that the television picture will be consistently accompanied by the corresponding sound of telephonic material. While some of the details of home television-telephone reception will be given under the study of topic (*b*) hereafter, it may be postulated here that such television will be accomplished by the use of:

1. an electronic pick-up rather than by a mechanico-optical pick-up. (Such pick-ups include the iconoscope and the dissector tube);
2. an ultra-short wave transmitter

or transmitters for the television and telephone portions of the program;

3. a coaxial-conductor cable, or its equivalent, or an ultra-short wave radio relay system, for the syndication of the program material for network operation, and

4. an electronic receiver of the cathode-ray type, with a fluorescent image screen, rather than a mechanico-optical receiving system. It is impracticable within the limits of this paper to discuss the principles, design. construction or operation of the complicated devices mentioned above.

Home Television vs. Motion Pictures in the Theatre

Proceeding to the study of topic (*b*), there will be given an itemized and instructive comparison of the practical results to be expected by home television-telephone reception as compared with the motion picture theatre performance.

1. *Mode of Picture Production.* The methods of producing the pictures are entirely different in the two cases, odd as that may seem. The theatre picture is projected as a complete unit, one entire frame at a time. The delineation is produced and limited by aggregates of silver grains in the developed positive image. The television picture is produced by a luminous dot (or "dot-element"), the brightness of which is accurately controlled as it passes in succession over a series of parallel and closely adjacent lines until it has covered the entire area of one frame.

In the theatre case, the entire picture is on the screen at the same time, to be succeeded by darkness prior to the projection of the next frame, and so on. In the television case, there is never anything more than a more or less bright dot on the screen!! The television picture depends even more on persistence of vision than the theatre picture, being in fact nothing more than a flickering and flying dot.

It must be added that certain technical details of television picture production have not as yet been standardized. However, the aforementioned features appear likely to be permanently present.

2. *Number of Picture Elements.* The number of picture elements determines the detail or, roughly, the story-telling capabilities of the picture. In round numbers, the theatre picture has something of the order of 5,000,000 picture elements; whereas even a good home television picture will probably have something like 150,000 elements. This is a ratio of 30-to-1 in favor of the theatre picture. However, it must be noted that the entertainment value of a picture in motion (whether produced by projection or by television) is not in direct proportion to the number of picture elements which it contains, so that we are not entitled to draw the conclusion that theatre pictures, though more detailed in structure, are necessarily far more entertaining (particularly on the small home screen) than television pictures. Probably a television picture in the home will be described by most as a "fair home movie."

Line Structure—Color

3. *Grain or Line Structure.* Theatre pictures of reasonable size from a suitable positive show negligible grain if viewed at moderate and practicable distances, and of course show no line structure (for monochrome pictures). Television pictures show no grain structure, but may show a slight line structure if viewed too closely. However, high-detail television pictures, viewed at normally comfortable distances, will show practically no line structure—and certainly no objectionable line structure.

4. *Color of the Picture.* Theatre pictures are normally black in the shadows and white (blue-white or yellow-white) in the highlights. When projected from toned or tinted positives, they show the corresponding hue. Television pictures are also practically black in the shadows, but the highlights may be bright yellow, greenish yellow, or even a practically neutral white. The latter color will probably become common practice in television as development of that art proceeds.

5. *Possibility of Full-Color Pictures.* It is readily possible today to produce theatre pictures which show substantially the colors of nature, or, at least, an acceptable approximation thereto, although there are definite economic handicaps in production and reproduction of such pictures. Television in full-colors seems to be an almost impracticable proposition in the present or likely early state of that art, although small-scale demonstrations of its abstract possibility have indeed been given.

Comparative Picture Size

6. *Size of the Picture.* Theatre pictures range in size from, say, 6 to 8 feet to perhaps 18 by 24 feet, or even more in special cases. Thus their area is between 48 and 432 square feet. Home television pictures range from about 6 by 8 inches to perhaps 18 by 24 inches, or, in special cases, somewhat more (though generally at the cost of picture detail and brightness). Thus their area lies between about 0.3 and 3 square feet.

On this basis the area of the theatre picture is about 150 times that of the home television picture. A more normal comparison would be with the approximate 30-by-40 inch *home* motion picture, having an area of about 8 square feet, or say about 5 times that of the average television picture.

7. *Picture Brightness.* Theatre pictures are generally adequately bright for viewing in a darkened auditorium (that is, an auditorium with illumination about 0.5 foot-candle). The television pictures are also sufficiently bright to be viewed in a dimly lit room—but dark shades will be required for daylight hours, and for the evening as well, if street lighting is at all bright outside the home.

8. *Flicker of the Picture.* The theatre picture consists of 24 frames per second, each of which is generally projected twice before the next frame reaches the screen. Flicker is absent, although traces of an effect depending on picture sequence are still found in the case of rapidly moving objects and in the stroboscopic backward-turning of the wheels of pictured vehicles.

Television pictures may be projected in two sets of 30 pictures each, the two sets being projected in 1 second. Interlaced scanning may be used, and under these conditions a substantially flickerless picture is obtained. Despite the projection of 60-half-detail pictures per second by this method (equivalent closely to 30 full-detail pictures per second), it is possible to use ordinary 24-frame per-second motion picture film for the television subject without undue difficulty

Television Quotes

The relationship between motion pictures and television has been made the subject of numerous effusions which, even from a charitable viewpoint, must be characterized as highly imaginative and distinctly misleading.

The television picture depends even more on persistence of vision than the theatre picture, being in fact nothing more than a flickering and flying dot.

Television in full-colors seems to be an almost impracticable proposition in the present or likely early state of the art.

Their area (television pictures) lies between about 0.3 and 3 square feet.

The theatre has a number of definite and inherent advantages as a showplace.

People are interested in change (from the home). . . . also, people are gregarious and somehow seem to have their emotional responses enhanced by crowd enthusiasm.

The theatre need not be unduly apprehensive over the advent of television.

Given its natural advantages, a forward-looking attitude, real initiative and careful planning, there appears to be little doubt that the motion picture theatre can hold an enviable position of public acceptance and resulting prosperity in the future.

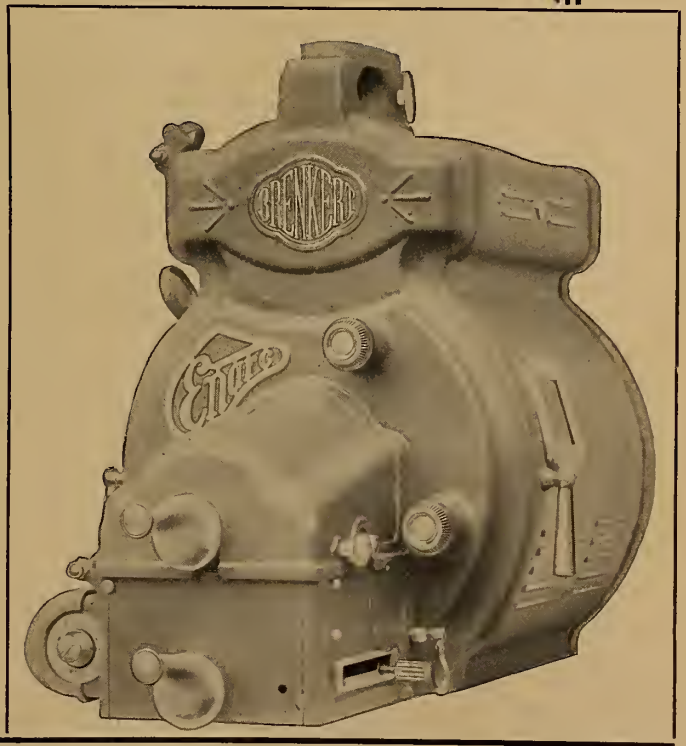
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by the use of technical expedients which cannot be here described.

Viewing Distance; Audience Size

9. *Viewing Distance.* Taking an optimum viewing distance of 4.5 or 5 times the picture diagonal, theatre pictures may be most conveniently viewed at from 45 to 135 feet from the screen, while home television pictures will be viewed from about 4 to 11 feet from the screen. This is a ratio of viewing distances of about 11-to-1 in the two cases.

10. *Audience Size.* Long experience has demonstrated that the comfortable size for theatre audiences ranges from 500 to 5,000 persons, with perhaps some doubt at one extreme or the other. The corresponding home audience may be expected to lie between 3 and 15 persons, a ratio in favor of the theatre of about 200-to-1. It must not be inferred, however, that the economic ratio for the two fields is anything like as high as this; indeed it has not yet been determined just what will be the cost per person per hour of entertainment for home television-telephone broadcasting.

11. *Synchronism of Picture with Sound.* In the theatre, the picture and sound are correctly associated within 1/24th of a second, assuming proper editing and threading. In the case of home television-telephone programs, the synchronism is even closer (though this is not noticeable as an advantage), and is entirely correct and automatic. Some rather romantic writers on this subject have dilated on the "marvel" of the synchronism of picture and sound in such programs. As a matter of fact, considering the fundamentals of the processes employed, it would be even more marvelous if synchronism were not obtained for television-telephone broadcasting reception.

It is not practicable at this time, before mass production of television equipment has been initiated, to give a reliable comparison of the cost of theatre and home equipment. In a general way it may be said that theatre equipment costs in the *thousands* of dollars and home equipment about the same number of *hundreds* of dollars, thus giving a cost ratio of perhaps 10-to-1. Here again some caution must be used in interpreting such figures, since there are numerous other economic factors involved in a valid comparison.

WHILE it is not feasible within the limits of this presentation to give even an outline of the various methods employed in modern television, some numerical data concerned with picture detail may be included as of present interest.

These consist first of a personal opinion, in terms of motion picture terminology. of the value and characteristics of television pictures having various numbers of dot-elements composing them. The figures are understood to be merely generally descriptive, but it is believed they are instructive in judging the "motion-picture value" of various television systems:

10,000-element pictures—these give a fair close-up of a single person (head and shoulders).

20,000-element pictures—these can show two persons in a close-up moderately well (though without fine detail).

40,000-element pictures—fair medium shots become possible.

80,000-element pictures—good medium shots, and acceptable long shots shown.

160,000-element pictures — excellent close-ups of several persons, good medium shots. and fair long shots can be

(*Continued on page* 28)

DOUBLE REEL DEFERRED; I. A. OPPOSITION, EQUIPMENT TROUBLE SEEN AS FACTORS

INTRODUCTION of the double reel as an industry standard, twice deferred, has again been postponed from April 1 to August 1, it was announced by the Academy of M. P. Arts & Sciences, co-sponsor with the Hays office of the project. This further delay was attributed officially to "manufacturing difficulties" and to "scattered complaints" from theatres having equipment which can not accommodate the proposed new length of 1750 feet.

Informed quarters saw in this latest postponement a reflection of strong opposition among projectionist local unions of the I. A. which announced emphatic disapproval of the longer reel length. Naturally, this pronouncement by the parent body served to solidify and intensify the opposition of local units.

The effect of "manufacturing difficulties" mentioned in the official announcement of the postponement was discounted in technical circles, in view of the fact that the double reel has been ballyhooed as a certainty for almost a year, with specifications having been available for at least five months prior to April 1. The nature of these "difficulties" is a matter for keen speculation in informed technical circles.

Equipment Complaints Valid

The equipment complaints are known to be valid. As reported in these columns, about two hundred theatres throughout the country, mostly in Western small towns, still use the old-style Powers projectors, which are more than 17 years old. Some of these equipments can accommodate only a 12-inch reel, while others can use, at most, a 14-inch reel. The equipment necessary to modernize these outfits for use with the new reel standard of 15 inches, having a 5-inch hub (a complete stand, with upper and lower magazines) would cost about $200 —which figure, incidentally, is about the same as the entire Powers outfit cost when new.

Observers are at loss to understand why these comparatively few theatres should exert such influence in effecting a postponement of the longer reel, because it is specifically understood by the Academy and the distributors that those theatres unable to handle the longer reel length will be supplied with film in the usual 1000-foot lengths, in which form the film will be shipped to exchanges.

It is precisely upon this score that I. P. objects to plans for the double reel. With film being sent from the laboratory to the exchange in 1000-foot lengths, the task of joining two short lengths into one long double reel will rest with the exchanges. Nothing in the record of exchanges to date in connection with the much easier job of merely inspecting the film, I. P. contends, warrants the reposing of such confidence in exchanges to handle the very much more difficult task of properly joining two lengths of film into a longer reel.

Thus far, I. P. has not seen samples of approved shipping cases or reels, on the score of which there exists no little doubt as to adaptability, in view of the ridiculously low prices announced for these accessories. Further, it appears that there is to be no officially approved source for this equipment, every distributor being free to contract for his own supply. There exists much doubt, therefore, as to the quality of reels and cases.

Exhibitors Favor Long Reel

Seventy-eight per cent of all U. S. exhibitors are said to be in favor of the longer reel, according to a survey made by *Motion Picture Herald*, an exhibitor paper. Some 6 per cent of exhibitors are non-committal on the project, while 16 per cent are opposed, the latter group being represented as doubtful about increased costs of equipment changes and the shipping of film. Obviously, few exhibitors are sufficiently well informed of, or even interested in, the technical requisites involved.

It is probably no exaggeration to state that postponement of the double-reel standard reflects, more than anything else the increasing opposition of organized Labor to the change. What the final outcome of the matter will be is difficult to forecast at this time.

Servicing Theatre Sound Picture Reproducing Equipment

By C. C. AIKEN
RCA MANUFACTURING COMPANY

ONCE a sound motion picture reproducing equipment is installed in a theatre, the following problems are faced:

(1) Maintaining high quality.
(2) Avoiding faulty operation and failures.
(3) Adjusting to changing recordings.
(4) Adjusting to new standards.
(5) Modernizing when feasible.
(6) Gaining experience leading to advancement.

The maintenance of high-quality reproduction depends largely upon the same factors that are involved in design:

(*a*) The beam from the exciter lamp must be uniform, steady in intensity, of the proper size, and vibrationless.

(*b*) The movement of the film must be free from variation in linear speed, weaving, or fluttering.

(*c*) The electrical system must be free from extraneous noise or distortion, and must have sufficient amplification and a proper frequency response characteristic.

(*d*) The conversion from electrical impulses to sound waves must be without extraneous noise or distortion.

(*e*) The sound waves must be directed so as to provide uniform results throughout the auditorium, without allowing the room itself to introduce objectionable factors.

The standards of performance and the methods of measuring items (*a*) to (*d*) are determined in the laboratory in connection with the design. By extremely close contact between the field and the laboratory groups, the initial standards and methods and the subsequent changes are made known and put into operation in the field.

Criteria of Quality

The final criterion of quality is the human ear; but as between various persons, the response of the ear varies enormously. Audiometer tests show a variation of as much as 40 db. among individuals. For a given person, the ear responds differently from hour to hour. To avoid having such variation introduce inconsistencies, the standards set up in the laboratory, in so far as possible, are expressed in terms of *objective measurements* rather than *subjective sensations.*

Vital factors in a well-rounded servicing program for theatre sound reproducing systems are contained in this article, first presented before the S.M.P.E. Projectionists generally, and particularly those already engaged in servicing work, will find much of interest and value therein.

In many cases, the objective laboratory methods have been found to be directly applicable to field use, providing accurate, stable standards for the maintenance of high-quality reproduction. In cases when the ear must be relied upon without the aid of objective measurements, it is necessary to devise special tests by means of which defects in reproduction are caused to be accentuated so that the trained ear can readily detect them regardless of the listener's state of fatigue. In this respect it is important that the field engineer develop an acute sense of hearing by long and continuous training. He must have an excellent standard of comparison and must have had long experience listening to reproduction under many conditions if he is to be able to diagnose equipment accurately to determine whether it is in the best of condition or not.

Experience Determines Procedure

The field practice to be followed in correcting faulty functioning and failures is determined by experience. The proper procedure is the one that works best by actual test. Systematic accumulation of experience of a large field force in thousands of theatres forms the best possible basis upon which to lay the foundations for these procedures. In the same way that the design of equipment undergoes change from year to year as new and better methods are developed, field procedures go through an ever improving evolution.

Closely allied with the application of field experience to field practice is the application of field experience to engineering and research. Theory and practice are prone to diverge unless theory is constantly checked against actual results. The sound motion picture art can not develop at the speed it should unless it takes full advantage of its experience. By watching the leaders of the industry, smaller companies are prevented from diverging too far from the path of sound progress, but for the good of the motion picture business as a whole the larger companies may not neglect to follow the products of their development.

The recordings of some producers are lacking in the bass; others over-emphasize the bass notes, and in some the high-frequency response is so garbled as to make it necessary to equalize the highs. As a rule, a satisfactory compromise best suited for the product being shown at the time can be found. But for best performance, changes in the reproducer characteristics are required to be made when the majority of features shown in a theatre are obtained from a different producer or when a change is made in the recording characteristics.

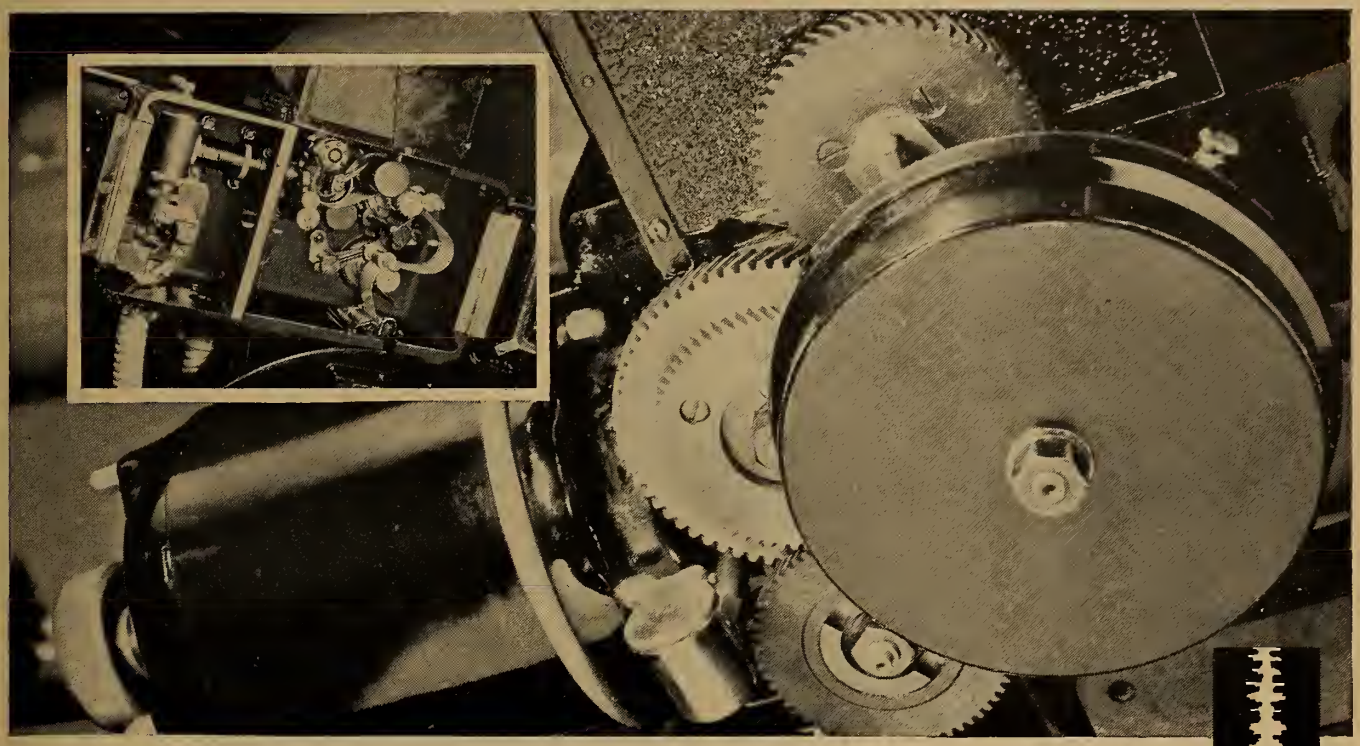
Fads introduced in the march toward perfect reproduction carry us too far, first in one direction and then in another. At one time popular opinion required crisp speech of optimal intelligibility; and, at another time, booming, roaring, low-frequency response was demanded. As a matter of good business policy it is necessary to adjust the theatre equipment in accordance with the prevailing tastes, and to change them as the tastes vary.

In spite of, or, perhaps because of, the vicissitudes of show business, progress has been rapid. New tastes, new developments, new requirements have made obsolete in a few years the early theatre equipment (and should have made obsolete much of the recording equipment), demanding either the purchase of new and modern equipment or

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a major and almost equally expensive, though less effective, renovation of the old equipment. As improvements become available, they can, and should, be made in order that existing installations may be kept as modern as possible.

So far the problem has been viewed largely from the standpoint of the technician. Exhibitors are interested in the problem from an entirely different standpoint: that of dollars and cents. Here is the problem of expressing an intangible "quality of reproduction" in terms of tangible "box-office receipts." The many variables, *e. g.*, entertainment value of pictures shown, general business conditions, amount and kind of advertising, *etc.*, make a quantitative analysis impossible or inaccurate. Certain facts can, however, be established from which to draw conclusions, and by checking such conclusions against a sufficiently large number of experiences, determine their accuracy.

High-Quality Maintenance

Most important of all factors to the exhibitor is the maintenance of high-quality reproduction. In every audience there is an increasingly large percentage of music lovers and critical listeners. Rarely do they analyze the sound equipment when it is "off-color"; rather do they say, "I did not enjoy that picture," or, "Her voice is not so good," blaming the actor or the producer and discouraging their friends from attending the theatre. This reacts not only to the detriment of the one exhibitor, but slightly "off-color" sound in neighboring theatres can cause a general degeneration of interest in pictures and adversely effect the attendance of all theatres. An exhibitor should pray, "Let my competitor have *obviously poor* sound or *very good* sound, but let him *not* have *fairly good* sound which will eliminate the thrill of a glorious voice."

The experience of many exhibitors has proved that music lovers and critical listeners are found as frequently in negro and foreign districts as on Broadway. Experience has proved, also, that a decrease of attendance occurs as a direct result of imperfect tonal quality. Critical listeners and music lovers are the first to lose interest. The poorer the quality the larger is the number of patrons affected. Many patrons will have lost their show-going habit before noticeable dissatisfaction becomes evident.

Fine Projectionist Co-operation

We have already named the factors that enter into the maintenance of high-quality reproduction. Projectionists have risen splendidly to the difficult job of operating and caring for reproducer apparatus so as to minimize the possible change of quality between service calls. That such change of quality does exist is attested by the fact that no manufacturer of sound motion picture apparatus has long existed who did not set up and maintain a policy of periodic service. From the exhibitor's point of view the bankruptcy of a manufacturer is sad; but the exhibitor is much more concerned with the fact that the *immediate* cause of the bankruptcy lies in the theatre, and not in the factory.

Frequency of Service

Because of the impossibility of expressing the subjective quality of sound in per cent, the discussion thus far has been qualitative, not quantitative. Quantitative study can be made by comparing the cost of routine service against the loss in box-office receipts occasioned by impaired quality of reproduction. If the loss in box-office receipts just balances the investment in a periodic service call, the result of the investment is increased satisfaction, security from interruption, and peace of mind for the exhibitor for no net change in his finances. If the period between routine calls is too great, the decrease in box-office revenue exceeds the cost of additional service, and the reputation and net profit of the theatre will suffer.

A surprisingly small percentage increase in daily attendance is required to balance the cost of periodic service. This, like other investments, should afford exhibitors an opportunity for a profit. Experience has shown that service properly rendered, by competent men, well trained, properly equipped, and backed by an organization having full knowledge of all phases of the industry, yields to exhibitors a profit far in excess of the generally accepted six per cent.

Questions and Answers on Motor Generators

By JOHN HERTNER

HERTNER ELECTRIC COMPANY

In this space each month will appear questions and answers on motor generators and other projection problems relating to power supply. Readers are invited to submit their own problems, the answers to which will be supplied by Mr. John Hertner, whose long association with the projection field eminently qualifies him to render valuable service in this respect.

This month's question, one that comes up again and again, relates to the fundamental relationship between voltage current and resistance, applying whenever a resistance is used in connection with current regulation.

Question No. 1

"I am operating a low intensity lamp at about 25 amperes off an 80-volt generator. I find that the rheostat gets pretty warm, although only a part of the coils heat up, the rest remaining cold. These coils consist of fine wire wound up into coiled springs and stretched over an asbestos support.

"Is there any way of reducing the heat on the rheostat?"

Answer

There are a number of conditions that might exist which could cause a condition of this kind. Assuming that the rheostat is one designed for use with your type of arc and on an 80-volt generator, it would appear that you are carrying too short an arc.

The proper voltage for the low-intensity arc is about 53 to 55, and the arc length should be adjusted so as to show this voltage. It will be well worth while to run a pair of cords from the voltmeter on your panel direct to the carbons for making this test, if another voltmeter cannot be had. The rheostat should then be readjusted so as to deliver the amperes required.

This condition is often encountered in the theatre. Suppose the arc voltage is permitted to drop to 40. Then the difference between 80 and 40 (or 40) must be lost in the ballast in place of 25 volts when the arc is maintained at 55.

Effect of Overload

In the multiple-coil rheostat, which is generally used and which apparently this inquirer has, the 40-volt drop necessitates the cutting out of some of the coils, or the current would use from the 25 desired to about 40 amperes. In cutting out such coils, those retained will have to carry 25 amperes where they were intended to carry only about 15. The final result is that the coils which were to carry 15 amperes at 25 volts drop are now loaded to 25 amperes at 40 volts drop, which is more than double the heat normally intended.

If, when running at the proper arc voltage, the current is not quite what is desired, it can be increased or decreased somewhat by changing the generator voltage through resetting the field regulator.

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Step-By-Step Analysis of Sound Reproducing Equipment

By AARON NADELL

XVIII. Western Electric TA 4035 and 4036 Power Units

THE W. E. TA-4037 filter was described in the December issue as a unit which might be added, as occasion required, to the power supply rectifier also described in the same article, and that would serve either to light the d. c. filaments of a W. E. 41 or a 46 amplifier or to provide button current for a W. E. carbon microphone. The same filter is also used, when required, with the rectifier power diagrammed in Fig. 1 herein. It may likewise be used with Fig. 2 herein, but in that case only for microphone current, since Fig. 2 incorporates its own filtered current supply for a 41 or a 46.

In Fig. 1 the a. c. power input is at the left of the drawing, shown by two arrowheads. The lower of the two leads to the tapped side of the power transformer. It is a flexible connection and can be tied to any of six input terminals, according to the line voltage encountered. In the actual unit, those terminals are located behind the tungar bulbs and are readily accessible, since each bulb, with its socket, can be pulled free of three spring-tension holding clips through which electrical contact is made, and removed from the rectifier entirely

The secondary of the power transformers consists of three windings, the first of which lights the filament of the upper rectifier tube, V-1. From the top of that winding trace right, down to the first junction, left to the filament of V-1, through that filament and then right, up and left to the bottom end of the same secondary.

The bottom secondary performs a similar function for V-2, the lower rectifier bulb. From the lower end of that secondary trace right, up to the first junction, left through the filament, and then right, down and left to the upper end of the same winding.

The long, central secondary provides plate power for the two tubes, and is the source of the d. c. drawn from this rectifier. The center tap of that secondary, of course, is the negative d. c. terminal. The two ends are alternately positive and negative with reference to that center-tap. However, the upper and lower ends of the secondary windings are connected, through the fuses F-1 and F-2, to the plates of the two rectifying tubes; therefore, only that end of the plate secondary which is positive is operative at any given moment, consequently the center-tap is always negative with reference to whichever end of the winding is active.

Assuming the upper end of the plate secondary to be positive, and tracing from negative to positive, as the electrons move, the circuit is:

From the center-tap of the plate secondary to the right all the way across the drawing and up to the three common negative output terminals, marked "Horn," "Mon" and "24V." Thence to the external load. The three positive output terminals are not commoned, hence there are three ways back to positive which must be traced separately.

Considering the first output load, the stage speakers, the input is through the terminal marked "Horn" and thence up and left through the ammeter by means of which that speaker field current is read and adjusted. Although the drawing does not show it, the scale of this instrument is divided into three sections, one for two, one for four, and one for six speaker units.

From the ammeter the circuit continues leftward through the fuse, F-3, and thence to the tapped resistor, R-1, by means of which the ammeter current is adjusted for the number of receivers in use. However, R-1 does not in itself provide sufficient adjustment for all possible current requirements that may be made upon this unit. To the right of and below R-1 may be seen the bleeder resistor, R-2, which bridges across the line, and just above R-2 a set of three terminals. A jumper, leading to the positive side of the line, is connected permanently to the upmost terminal. Where only two stage speakers are used, that jumper is joined to the terminal immediately below it, cutting R-2 into circuit across the line and thereby lowering the output voltage. Where four or six receivers are used, the jumper is connected to the bottom one of the three terminals, which is open, and R-2 is thus open-circuited.

Continuing left from R-1, the circuit runs past another bleeder resistor, R-3, and thence past a 24-volt signal bulb that shows at a glance from across the projection room whether this rectifier is operative; thence left to a filter condenser, C-1, connected across the line. The positive and negative polarity indicators, included in the drawing, show that this is an electrolytic condenser which must be connected in proper polarity, or it will break down. To the left of the condenser is the filter reactance, L-1.

Then the circuit continues left to the filament of V-1, and by emission across the vacuum to the plate of V-1, and through fuse F-1 to the upper end of the plate secondary of the power transformer, which, at the moment under consideration, is the positive side of the source.

Now, returning to the three common negative output terminals at the right of the drawing, consider the monitor speaker field to be the external load. The return is through the separate output terminal marked "Mon," and then left, down and left to the tapped resistor L-4, by means of which the voltage to the monitor can be regulated to compensate for other requirements placed upon this rectifier. To the left of R-4 is a bleeder resistor, R-5. The lower end of that resistor may be traced to the negative side of the monitor line as follows: down, left all the way, up to the first dot showing a point of junction, thence right all the way and up through the negative terminal marked "24V" to the negative terminal marked "Mon."

From R-5 the circuit being traced may be followed left to the electrolytic filter condenser, C-2, which also bridges the line, and thence to a filter reactance coil, which, like the one already seen in the stage speaker supply circuit, is labelled L-1 in this drawing—probably a draftsman's oversight. Thence left to the next point of junction, up to the point of junction just right of V-1, and through V-1 filament as before.

The return from the third output circuit, marked "24V," may be traced

down, left all the way, and up and left to V-1 filament. There is neither filter nor bleeder resistor in this circuit, nor is there a voltage-regulating series resistor. (All those facilities are provided in the W. E. TA-4037 Filter, shown as Fig. 2 in last month's article, which is always used with this circuit when applied. In some installations this last circuit is not used, and the two terminals marked "24V" are simply left open.)

When the upper end of the power transformer of Fig. 1 becomes negative, V-1 rectifier tube is inoperative, since electrons emitted from its filament are repelled by its negative plate, and the space between filament and plate performs the function of an open switch. During such alternations the lower end of the same secondary must, of course, be positive, and the circuits traced return to that end of the transformer as the positive terminals of the source of power. From the lower end of the filament of V-1, to which all of these circuits have already been traced, follow down to the upper end of the filament of V-2, through that filament, then by emission to the plate of V-2, through fuse F-2 and to the transformer.

With 60-cycle supply, the positive terminal of the d. c. circuits of this rectifier changes its location, of course, 120 times per second, moving from the top to the bottom of the transformer secondary, and back again.

During those times when the polarity of the secondary is changing, and neither tube is delivering material current, the output supply is kept constant by the discharge of the filter condensers and by the collapse of the magnetic fields around the filter reactances. Whenever either end of the secondary is strongly positive and maximum current flows across the space of one or the other of the tubes, the excess energy is absorbed in re-charging the filter condensers and in building up the magnetic fields around the reactance coils. Thus the output, except to the unfiltered output terminals, is kept relatively constant at all times.

It will be noted that there is only one stage of filtering (one coil and one condenser) in each of the two filtered circuits. The reason is that the power delivered goes to speaker field coils, which themselves constitute heavy reactance windings that to a degree filter their own current supply. Moreover, irregularity in current delivered to them is not amplified, thus excessive filtering is not required.

The W. E. TA-4037 filter, which operates with the unfiltered output of Fig. 1, (page 14 of I. P. for December, 1935) possesses two stages of filtering, that is, two coils and two condensers.

Circuits of Figure 2

Figure 2 represents a single power supply unit which actually consists of two separate rectifiers, independent of each other in every way except that the primary of the power transformer is common in both. Of these two rectifiers which are built togther in one cabinet as a single unit, one has three, and the other has four, output circuits, or a total of seven.

The two separate rectifiers of this unit are designated, in the drawing, as "Circuit No. 1" and "Circuit No. 2," legends to which effect can be seen at the right and at the left above the output circuits and to either side of the rectifier tube assembly. Four rectifier tubes are used, two in each circuit, labelled V-1 to V-4.

The input is at the top-right of the drawing, through the switch D-1. Then one side of the input circuit goes to the right-hand end of the power transformer primary, and the other line to the tap-switch arrangement, which compensates for line voltage variations, at the other end of the primary.

There are six secondaries: Fig. 1 of this article had three secondaries; while the secondaries of Fig. 2 are two sets of three each, each set resembling the arrangements of Fig. 1.

Beginning at the left of the drawing, there is the secondary that lights the filament of V-1. Next the plate secondary, center-tapped, for V-1 and V-2; then the filament secondary for V-2. Next the filament secondary of V-3, the center-tapped plate secondary for V-3 and V-4, and the filament secondary for V-4.

From the left-hand end of the left-hand secondary trace down and right to the filament of V-1, through that filament and left and up to the other side of the same winding. Skipping the next winding (plate supply, center-tapped) trace from the left-hand side of the third winding down and left to the filament of V-2, through that filament and then down, right and up to the other, or right-hand, side of the same winding.

From the fourth secondary, trace the left-hand lead down and right to the filament of V-3; through that filament and left and up to the other side of the coil. Shipping the next plate secondary, trace from the left side of the right-hand winding, down and left to the filament of V-4, and from the other side of that filament right and up to the right-hand end of the same source.

Now, returning to the left-hand plate secondary, trace from the center-tap, which is the negative side of the d. c. source, down, right and all the way down to the negative output terminal of the unfiltered 24-volt output. Through the external load (which may include the W. E. filter already referred to) and back in at the positive terminal of the same circuit. Thence straight up to the filament of V-2, then by emission from that filament to the plate of the same tube, and through fuse F-2 to the right-hand side of the secondary.

If the right-hand side happens to be negative at the moment, trace left from the point of junction just below the filament of V-2 to the filament of V-1, and then through the filament of V-1 to the left-hand end of the secondary. If the secondary is reversing polarity at the

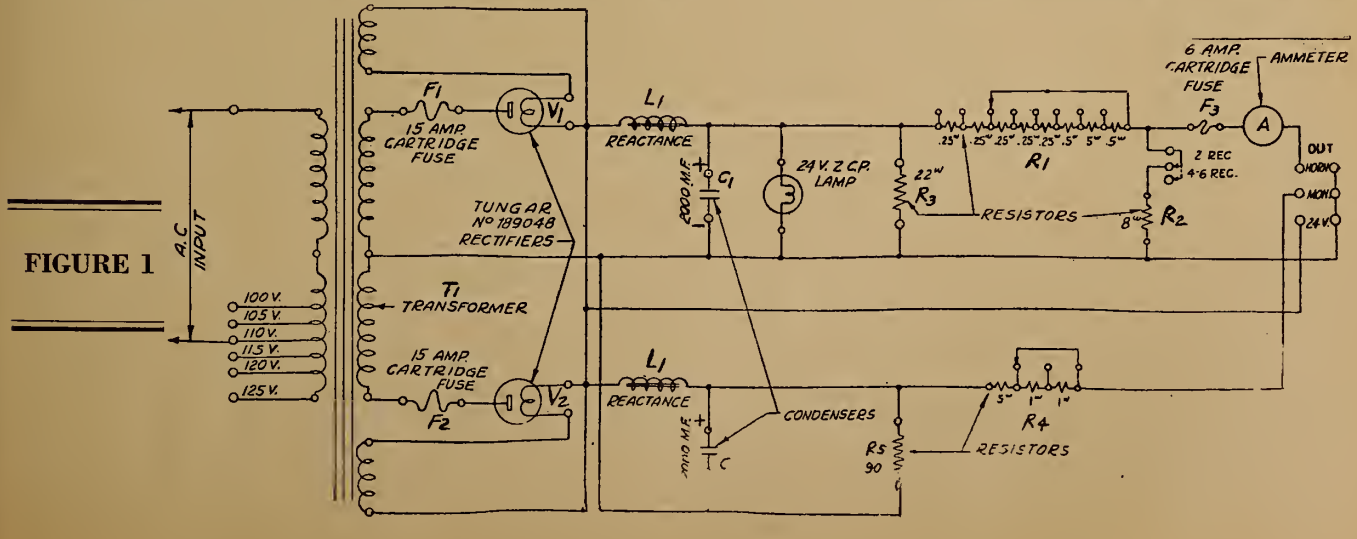


FIGURE 1

moment, there will be no current flowing through these output terminals, since this circuit is unfiltered; but in the filtered output circuits of the same rectifier, current will flow at all times. The d. c. source, at moments when the plate secondary is reversing polarity, will be the filter condensers and the collapsing magnetic fields around the filter reactors.

Returning to the center-tap of the transformer secondary of Circuit No. 1, trace down, right and down to the first junction; then left to No. 1 P.E.C. amplifier negative output terminal. Through the external load and in at the corresponding positive terminal, about an inch higher up, and then to the right through the voltage regulating tapped resistor, R-5. To the right past the bleeder resistor R-4 and the filter condenser C-8. Then right through filter reactor L-10, past filter condenser C-7, and through filter reactor L-9. From the right-hand side of that reactor up to the jumper that joins the filament of V-1 to the filament of V-2, and back to positive through whichever tube is operative at the moment.

The circuit next below is the No. 1 exciter lamp supply, the negative line of which is approximately as before. The positive return runs through the voltage regulating tapped resistor, R-2, past the bleeder, R-1, past the signal lamp E-1, and through a filter consisting of the condensers C-1 and C-2 and the chokes L-1 and L-2.

The bottom circuit of this rectifier includes only a single-stage filter, consisting of L-5 and C-11. There is a bleeder resistor, R-3. In addition, this circuit includes the 6-ampere fuse, F-5. This circuit provides power to signal lamps and bulls-eyes used elsewhere in the sound system, therefore it needs little filtering. However, if it were entirely unfiltered, the a. c. ripple in the bulls-eye supply circuits might be picked up by sound wiring running in the same conduit. Consequently, the failure of C-11 filter condenser may result in hum in the sound, even though only signal lamps, and no sound equipment of any kind, is directly supplied by its output.

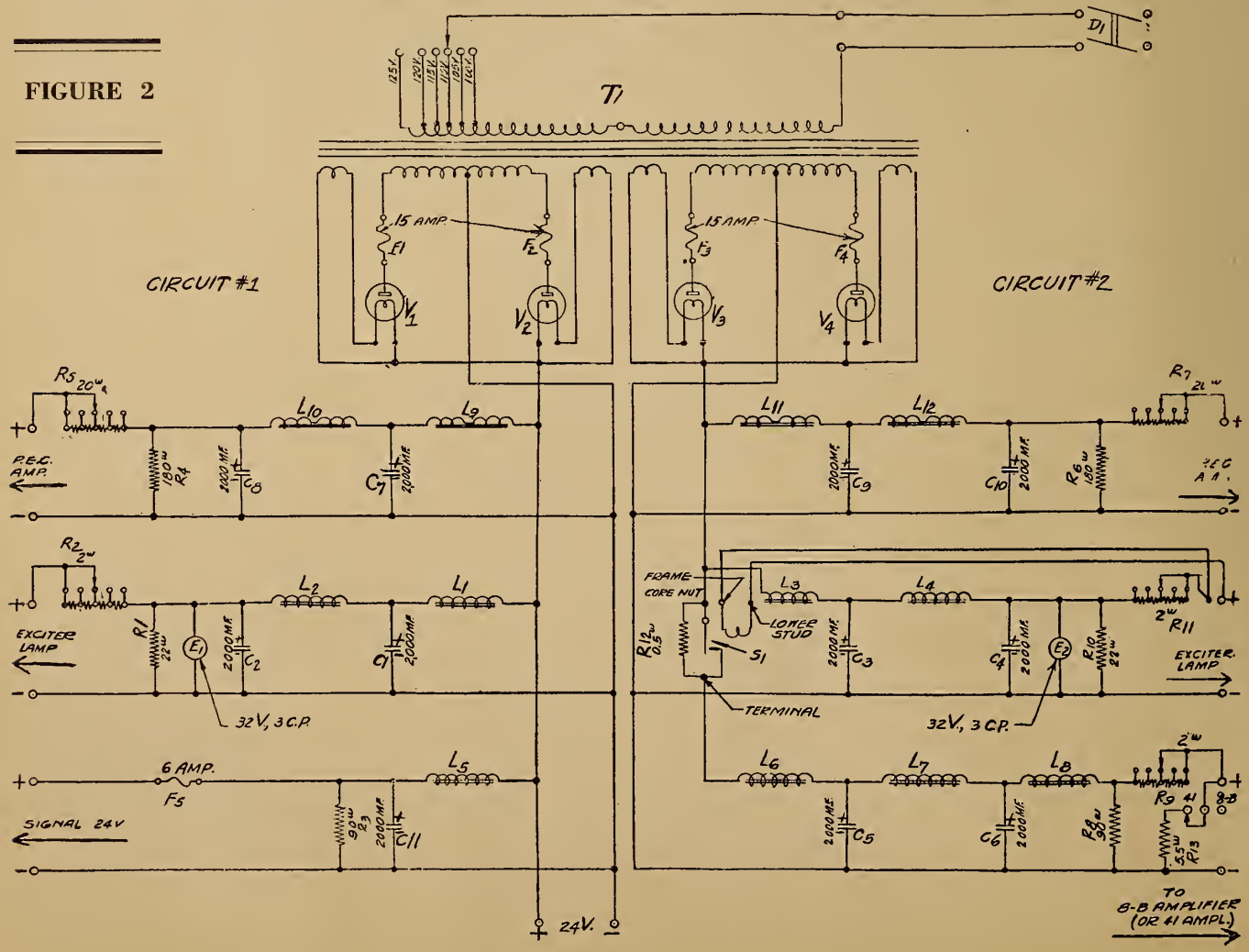
The right-hand rectifier circuit, No. 2, is essentially similar to, but not identical with, that already traced. The negative d. c. source is the center-tap of the right-hand plate secondary of the power transformer. The positive d. c. source is through the jumper that joins the filaments of V-3 and V-4.

Tracing from negative down, left and down to the first point of junction, the output to P.E.C. amplifier No. 2 may be traced to the right to the negative binding post for that circuit at the extreme right of the drawing. Following through the external load and in at the positive binding post, above, this circuit returns through the voltage-regulating tapped resistor R-7, past the bleeder R-6, and through the two-stage filter composed of L-11, L-12, and C-9 and C-10. From the left-hand end of L-11 trace directly up a short distance to the jumper between V-3 and V-4 filaments; thence through whichever tube is active to the positive side of the plate transformer secondary.

The circuit next below provides a relay, which operates if the exciter lamp is switched out or burns out, the object being to protect the bottom output circuit of this rectifier; therefore, that bottom is advantageously traced first.

Returning to negative, trace down, left and down to the bottom of the drawing, and then to the right to the negative output binding post leading to the system amplifier (41, 46 or 8-B, as the case may be). Back in at the positive terminal of the same circuit. If the amplifier is an 8-B, requiring 2.6 amperes, suitable adjustment is made at the three-terminal jumper arrangement shown between the output terminals. As drawn, the jumper from the central post

FIGURE 2



is at the left-hand post and connects bleeder R-13 across the line. This is the setting for the 41 or 46 amplifier, which draw approximately ¼ ampere filament current, the balance, which is available in case an 8-B is used, going through the bleeder R-13. With the jumper set at the right-hand terminal, which is open, R-13 is open and 2.6 amperes are available for the 8-B filaments.

One leg from the positive output terminal of this circuit, therefore, goes to this jumper arrangement; the other may be traced to the left through the voltage regulating tapped resistor R-9; past the bleeder R-8, and then through a filter consisting of three chokes, L-6, L-7 and L-8, and two condensers, C-5 and C-6.

From the left-hand end of L-6 trace left a bit, up, left a bit, up through resistor R-12, right a bit, and up to the jumper between filaments V-3 and V-4. Resistor R-12 is shunted by a relay contact. When that contact is closed, the resistor is short-circuited and current does not flow through it. The resistor is short-circuited (as will be seen) whenever exciter lamp No. 2 is lit. When that lamp is out, the relay contact is released and R-12 serves to protect the system amplifier against excessive voltage arising from the fact that the exciter lamp no longer constitutes a drain upon the current drawn through V-3 and V-4.

This exciter circuit may be traced from the negative source, the center-tap of the plate secondary of V-3 and V-4, down, left and down to the second point of junction, and then to the right to the exciter lamp negative output post. Through the lamp, and back in at the corresponding positive terminal. From that terminal up, left about three inches, and down to a connecting point marked "Lower Stud." Thence through the winding of the relay switch, L-1. The current through that winding holds the switch contact closed and short-circuits R-12, just to the left of that switch, as already stated. If the exciter lamp burns out, or is switched out at the projector, continuity is broken; current no longer flows through the "Lower Stud" to the relay winding; S-1 opens, and R-12 operates as a protective resistor in series with the supply to the system amplifier filaments.

Tracing from the lower stud, the circuit now under consideration continues through the relay coil, up through a contact marked "Frame Core Nut," to the right about three inches and down to a point just left of the exciter lamp positive output post. Thence left through the regulating resistor, R-11, past the bleeder R-10 and the signal lamp E-2, and left to a two-stage filter composed of L-3 and L-4 coils, and C-3 and C-4 condensers. From the left-hand end of L-3 upward, and left and up to the jumper between V-3 and V-4 filaments.

All the condensers shown in this drawing also carry polarity indications, and therefore are electrolytic condensers that must be connected in the proper polarity. In the physical equipment they fit into contact terminals, to which they are locked by thumb-screws, and the arrangement is such that only by carelessness can they be put in the wrong way.

• LETTERS TO THE EDITOR •

Spikes Report of Theatre Television Equipment

Sorry to have delayed answering your letter of Jan. 3, but was unable to get a definite answer on trade paper clipping you sent relative to installation of television equipment in a new theatre here. Had to finally contact the owner of the theatre by long-distance phone. The answer is "Positively no!" Owner would like to open with television, but would like trade paper that carried original item to tell him how it could be done.

Sorry I don't have something interesting to write on this, but hope foregoing will serve the craft.

E. L. Holem
Local, 570, Michigan City, Ind.

[Trade paper item forwarded to Mr. Holem stated unqualifiedly that new Michigan City theatre would have "Western Electric television projection equipment" installed. Mr. Holem's answer not only is reassuring, but also indicates valuable contributions that can be made to the craft by L. U. secretaries willing to do an occasional bit of correspondent's work. —*Editor.*]

Electrics Seek to Block State Education Aid

You may be interested to know that our Local (one in Calif.) has for some time now been receiving instruction through one of the State Trade Schools. The electrics have been very antagonistic toward this procedure, and have spread propaganda among the boys to the effect that the "course was no good", was "a waste of time" and not worthy of anybody "getting up early in the morning". It is reported, although impossible to verify, that the electrics planned to go before the authorities and have the course abolished.

This for your information, in view of your demonstrated interest in such matters.

A Projectionist
Los Angeles, Calif.

[I. P. would welcome definite proof that the electrics or any other group are interfering with projects such as the aforementioned. Upon receipt of such information, I. P. assures the craft that things would begin to happen to the interfering parties, things more tangible than any mere protest. Whether the electrics know it or not, their days of high-handed operations in this field are gone forever. If not careful, the electrics will lose more than servicing.—*Editor.*]

Thank You, Rochester

Enclosed herewith you will find our check in payment for a two year blanket subscription renewal. Local 253 as an organization, and every individual member, appreciates the extreme value of the information contained in every issue of I. P., and the great service you are performing for the craft.

Floyd B. Spencer
Local 253, Rochester, N. Y.

The Proposed Double Reel and Old Power Units

Some time ago you published a letter from a Nebraska supply dealer which pointed out that those theatres having the old Power projectors would be unable to accommodate the new double reel. Since then I have made a few inquiries which reveal that in this and adjacent territories there are more than 100 such Powers machines.

Don't you think that these theatres are entitled to consideration with respect to the drafting of the news reel specifications?

Ernest Chidsworth
Salt Lake City, Utah.

[This question is discussed elsewhere in this issue in an article relating to the double reel. In passing, it may be observed that "consideration" is a two-sided question, and that any projection mechanism more than 17 years old, as is the Powers machine herein referred to, might inspire thoughts of replacement. In any event, single-reel lengths still will be available under the new standard.—*Editor.*]

Thank You, Long Beach

Enclosed you will find remittance to cover the cost of a two-year subscription renewal of this Local to I. P. On behalf of our entire membership I wish to compliment you on your splendid magazine and to extend to you best wishes for a continuation of your great work in behalf of the craft.

G. A. Lahlum
Local 521, Long Beach, Calif.

Source of Supply For Sound System Parts

In all the discussion of sound system servicing I have failed to note any mention of sources of supply for sound systems, in the event projectionist organizations take over this work. I have heard some discussion, unofficial to be sure, of the electrics refusing to supply projectionists with necessary parts, in an effort to embarrass servicing operations. What is your view on this matter?

G. T. Hubbard
Local 511, Jacksonville, Fla.

[It would be poor policy for the electrics to refuse to supply genuine replacement parts, inasmuch as this is balanced by the power of many projectionist units to forbid entry into the projection room by electrics' servicing men. It has never been

enforced, true; but up to now there has been no apparent need for such action. A direct request for necessary parts would be the best course. Should the electrics refuse to cooperate, other independent sources are available. Also, a refusal might lead to some very interesting happenings where the electrics are concerned. —*Editor.*]

The Irrepressible 'Selenium Sam' Observes Further

How do you like those Audioscopiks now being distributed by M-G-M and advertised as "three-dimensional talkies"? Although I know your answer in advance, I must say that most people today fail to distinguish as between "depth" and "relief." Hmm, I notice that our old friend George K. Spoor threatens to return to the wars by producing more "three-dimensional" films.

The stuff in your Dec. issue by J. K. Elderkin (p. 18) is fine. I can't find a flaw in this anywhere. This man knows his stuff.

Comments by H. D. Waley (p. 17 of Dec. issue) appeal to me not at all. Who is to determine whether a given invention is "big" or "small"? Moreover, most "big" inventions really are a fusing of many "small" advances in an art. Mr. Waley's remarks on the "anaglyph" also don't appeal to me.

SAMUEL WEIN
Bronx, N. Y. City.

[M-G-M's Audioscopiks are old stuff, possible anytime with the past 25 years. In fact, just such pictures have been made and shown. Use of an analyzer to give the effect of three-dimensional movies, as repeatedly pointed out herein, does not constitute an intelligent approach to the problem. Projectionists should not take seriously these over-ballyhooed short subjects.

We agree with Mr. Wein's estimate of the Waley comments on inventions. Still, the Waley observations anent the anaglyph merely confirm the opinions of both Mr. Wein and this publication that this road will not lead to success with three-dimensional pictures. Why, then, the squawk? No theatre audience will long submit to the discomfort of using analyzers. As it was in the past, so will it be in the future. —*Editor.*]

"Roxy's" Death Recalls Contributions to the Projection Art and Craft

COMPARATIVELY few persons knew the name Samuel Lionel Rothafel. As "Roxy," who in the United States didn't know of him? He spread the name upon the air. The palace-cathedral-theatres where his genius expressed itself proclaimed and echoed it. The master showman, the artist in grandiose and "gorgeous" effects, must have had to smile sometimes for pride in his fame. He assembled the arts for an ever greater greatest show on earth. He was always building more stately mansions for his idea. Imposing architecture, splendors, perhaps too splendid, of decoration, orchestra like regiments, seas of light—he never could get enough even if he got too much.

Every detail must be in keeping. The weak-eyed were dazzled, the shy abashed, by the magnificence of his ushers; but they were models of deportment. Without thinking about it "Roxy" must have softened the manners of millions. He was generous to his audiences, giving them the film, the theatre, the radio and music. At the "Roxy" and still more at the Music Hall, one felt like the beggar who was Caliph for a day. One came in concerned about the ruptures in his shirt-cuffs.

"Roxy's" energy, fertility, variety and talent for publicity were incredible. His projects were so ambitious that only a Roman emperor who held the purse of the State would have been his sufficient coadjutor; and even the Golden House (Metropolitan Opera) might have seemed too small for "Roxy's" soaring plans.—*New York Times.*

The foregoing well-nigh perfect tribute to "Roxy" gives only the remotest indication of this master showman's many contributions to the art of projection. As a member of the American Projection Society, "Roxy" wanted not only "seas of light" but insisted upon the best projection. He it was who coined the term that he had "nothing but good projection to sell."

Was Prodigal With Light

"Roxy" was prodigal with light; his current and equipment bills were enormous. Ample manpower was to "Roxy" only a means for getting a particular effect letter-perfect. Interesting reminiscenses of "Roxy's" part in the development of the high-intensity arc as it is known today are supplied by Theodore Hall, of Hall & Connolly, pioneer h. i. arc manufacturers.

"'Roxy' never could get sufficient light," relates Mr. Hall. "Back in 1919 'Roxy' heard about the 75-ampere projection lamp I had developed at the Sperry Gyroscope Laboratories and had demonstrated at a convention in Cleveland. He just had to have it, and immediately, without any excuses about further necessary development work.

"The lamp, although fully automatic, was rather crude and unsuitable for projection, but 'Roxy' was concerned only with the fact that it delivered more light than he was getting. He ordered three lamps and granted permission to use the Capitol Theatre (N. Y.) projection room for experiments under actual operating conditions. In turn he exacted the promise that we would not occasion a break in his show.

"This promise was not kept, naturally, but 'Roxy' was kindly and patient through it all, his eye being focussed on that day when, with these lamps, he would drown his competitors in a torrent of light.

"Well, we 'experimented' at the Capitol for three years, changing designs, tearing out and putting in lamps, and all sorts of things. 'Roxy' never lost faith through the period, despite the obvious fact that such work inevitably means plenty of 'grief' for the theatre and the crew. When the final design was set, 'Roxy' was as happy as a schoolboy on the first day of summer vacation.

"There can be no dispute that 'Roxy' was the first to employ a high-intensity light source as we know it today for motion picture projection. Incidentally, completion of this lamp for 'Roxy' marked the formation of the Hall & Connolly Co., which shortly after the Capitol experiments was deluged with orders for similar lamps.

"Just how successfully 'Roxy' employed this improved light source is now one of the brighest pages in theatrical history. In later years at the Radio City Music Hall it was a common practice for 'Roxy' to utilize as many as twelve lamps, in addition to stage lights, on a single scene. This was an enormous quantity of light, true, but it also was masterly showmanship.

"Lighting contributed mightily to 'Roxy's' success, but it cannot be denied that he never took out of the art more than he put into it. If anything, the art was his debtor. Modern projection is heavily indebted to 'Roxy,' who blazed a trail in showmanship that required courage to follow."

Projectionist-Stagehand War Over Jurisdiction Looms

Rumbles of an impending tussle between stagehands and projectionists over jurisdictional rights within the I. A. emanated from the later's Executive Board sessions recently concluded in Miami. The differences have their root in a ruling several years ago by the I. A. that stagehands were entitled to all p. a. system work. Projection delegates to the Louisville convention fought unsuccessfully to overturn this ruling.

Latest manifestation of projectionist dissatisfaction on this score centered around recent ruling that stagehands be permitted to enter projection rooms to operate switchboards. Max Reinhardt's spectacle, "The Eternal Road," now readying in New York will use specially recorded RCA High Fidelity sound track on film in place of orchestra. Operation involves film lengths without picture, using regular sound heads. Members of Local 1 (N. Y. stagehands) were awarded work. Joseph Basson, president of Local 306 (N. Y. projectionists) is reported to have appealed this ruling to I. A. Executive Board, without success.

Some sixty West Coast projectionists locals are understood to have banded together to gain support of other units throughout the country for concerted action at the next I. A. convention to check this "encroachment" by stagehands. Appeals for the election of projectionist delegates are anticipated.

The IP EDITORIAL PAGE

Vol. 10, No. 1 JANUARY 1936

Again: That Organization Technical Bureau

The reaction to the plea made herein last month for an extension of technical activities within the national projectionist organization elicited a highly favorable response. Ordinarily we should be gratified at this show of co-operation by the craft; but we are forced to classify this sporadic outbreak of enthusiasm as unusually old stuff. The very best of intentions, if unaccompanied by some show of positive action, must fall short of attaining the goal marked out by I. P. Amusing indeed is that question which predominated craft comment upon our editorial: "How shall we do it?" To which I. P. can only reply, maybe curtly but none the less accurately: "Do it!"

An outstanding defect of projectionist organizations is their amazing ineptitude in any matter requiring coordinated craft action. Just by way of example, Omaha may do precisely as it pleases in any technical matter, however, relevant to the welfare or security of, for example, Atlanta. Not infrequently such moves arise to plague another local unit in an effort to obtain passage of beneficial legislation. If this be organization, if this be coordination, if this be an example of a cohesive "national" group, then I. P. prays to be delivered from association with such a group. Local autonomy is a high-sounding phrase, but it has no place in a progressive technical policy of any national organization. These are harsh words, and probably not to the liking of many local units; yet I. P. cannot refrain from uttering them.

No, we are not harping on the double-reel situation again. I. P. spoke its piece on the longer reel, not a month ago, not six months ago and not a year ago, but for the past five years. If organization opposition to the new reel standard within two months of its formal introduction could be so potent in giving pause to its sponsors, what could not have been accomplished by the same unity of action even as little as a year ago? If the craft finally is handed the double reel, I. P. can say that the craft invited it, earned it.

But the double reel does serve admirably to illustrate the point of the foregoing citation anent craft division in technical matters. What happened in this case was that sponsors of the double reel would enter City A and hie themselves to the proper authorities, where, with the aid of as many distributor representatives and politicians as could be mustered, they proceeded to "sell" the double reel. More often than not the local projectionist group did not object, primarily because it had never given calm consideration to the matter; but if the local unit did object, it was promptly steamrollered into submission merely by having the authorities announce acceptance of the proposed standard.

Meanwhile in City B the projectionists were putting up a whale of a battle against the double reel. Into their city sallied another, or possibly the same, agent for the double reel sponsors, and his first act was to cite the favorable action obtained in City B with the approval and "whole-hearted co-operation" of the projectionist unit belonging to the "same national organization as do the protesting projectionists" of City B.

This state of affairs is just ducky, and if any projectionist group cannot perceive the lunacy of such a situation, they are themselves fit subjects for a sanity examination.

But whatever losses are ultimately sustained through introduction of the double reel (which date has now been advanced from April to August 1) might be turned to good advantage, if only the craft will take the lessons thereof to heart. I. P. readily admits that its advocacy of a technical bureau in the national headquarters of the organization is prompted by no great love for exhibitors or even for manufacturers, but rather was inspired by the desire to see projectionists exert more influence over the entire projection process—including not only the operation but also the purchase, installation and servicing of all equipment. I. P.'s sound servicing campaign is directed to the same end. We have heard much talk on the score of "organizing," which seems to us an ill-defined term as generally used by the craft. If anybody can conceive of a better aid to organizing than vesting complete control of the entire projection set-up, including equipment, in the hands of organization members, we'll eat an entire issue of this publication.

Any member of the I.B.E.W., our esteemed sister organization, can write to national headquarters and get the low-down on any unit of equipment, on any craft practice relating to his work. What's good medicine for I.B.E.W. surely is not poison for I. A.

Some there will be who will laugh off this suggestion, holding that it is not a burning question right now and must give precedence to "more important" problems. Maybe these critics are 100% correct; yet that phrase "more important" has a strangely reminiscent ring dating back to the time before sound pictures sets were installed and before one-man shifts had become the rule rather than the exception. "More important" is a phrase long overworked by indolent, short-sighted organization men. We vote to retire it permanently.

Practical vs. Theoretical Projection

Those projection stalwarts resident in the citadel of culture (where else but Boston?) have just completed a series of tests relative to the general efficiency of various carbon arcs, with particular emphasis upon the heat-radiating properties of the comparatively new Suprex arc. The tally sheets of this investigation have not been reviewed as yet by I. P., which task will be executed shortly, but advance reports indicate that several surprises are in store for those who thought they knew all there was to be known about carbon arcs.

For months now I. P. has urged a thorough reexamination by a competent group of the Suprex arc, based upon practical rather than theoretical considerations. Undoubtedly the Suprex arc is a highly efficient and economical light source; yet there was all too much squabbling and divided opinion relative to design, construction and best operating requirements (not to mention the most advantageous power supply) therefor. I. P. recommends this reexamination service for all equipment, not only for the Suprex arc, about a year after its general introduction. Much that is theoretically sound becomes of dubious practical value after being subjected to actual projection room operating conditions.

Nobody has yet successfully disputed that old saying that the best design technique and manufacturing procedure can be improved upon by a projectionist after daily operation of a unit for a few months.

Color Motion Pictures At The Crossroads

The second all-color feature picture is shortly to be released—to be accompanied, we may be sure, by another hurricane of publicity anent the "naturalness" and "psychological reactions" of colored motion pictures. It is not I. P.'s function to belittle the earnest efforts of those who seek to expand the influence of, and attract added patrons to, the motion picture; nor de we begrudge the harassed publicity men their little fling. Like ever so many other things, however, there must be some vestige of legitimacy

(*Continued on next page*)

MANUFACTURERS ENDORSE I. P. STAND ON EQUIPMENT DATA

Operadio Mfg. Co., Recognizing Craft Needs and Rights, Extend Full Co-operation, Removing Objections; Other Makers Pledge Full Support and Craft Recognition

By JAMES J. FINN

THE prestige and authority of the craft over the projection process was enhanced during the month by the widespread approval accorded by manufacturers to I. P.'s stand that complete details of every unit of projection equipment be made available to the man whose responsibility it is to see that the show goes on—the projectionist. There were a few dissenters, of course, but they comprised a negligible minority.

Leading the parade of assenting manufacturers was the Operadio Mfg. Co., of St. Charles, Illinois, which company's unfamiliarity with approved procedure in this field precipitated the situation wherein I. P. considered it necessary to take a firm stand to force final settlement of the matter. Filing of requested data by Operadio removes any objection I. P. may have expressed to this company's sales policies and gains for this manufacturer the thanks of projectionists for prompt recognition of craft needs and rights.

I. P. regrets the circumstances under which the Operadio Mfg. Co. was cited as unwilling to co-operate, it appearing that only the absence on a business trip of Sales Manager Lawrence B. King operated to delay a satisfactory reply to I. P.'s second, and explanatory, request for schematics.

Many Manufacturers Approve

Typical of the many favorable comments received by I. P. from manufacturers of projection equipment, both visual and sound, is the following:

> In reading the December issue of your esteemed publication, we have taken note of the controversy which seems to be raging concerning the policy of secrecy on sound equipment data. . . . We believe that your stand on this matter is one that will eventually result in considerable improvement in . . . sound equipment operation and maintenance.
>
> It has always been the policy of our organization to present both the projectionist and our dealers with complete service data, if for no other reason than to selfishly obviate unnecessary returns of equipment to our factory.
>
> We are enclosing with this letter complete service data on our Model AQA amplifier and Series '75 amplifier. If there is any additional information which you believe should be kept in your files, together with any other form of co-operation we can offer to you, please feel free to call upon us.
>
> JOHN S. MECK
> The Clough-Brengle Co.
> Chicago, Illinois.

Many other favorable communications were received, not a few of which contained schematics of complete lines of equipment. Practically all correspondents agreed that the projectionist is entitled to every possible aid in the operation and maintenance of room equipment.

An interesting note as to the serious shortcomings of most servicing structures crept into not a few of these letters, lending confirmation to I. P.'s oft-expressed view that the projectionist on the spot is the best qualified to render service on *all* room equipment. Naturally, the craft cannot dodge the implications of added responsibility contained in this statement with respect to greater competence and alertness.

The dissenting votes, as previously cited, were few in number and weak in logic. The old bromide that a manufacturer cannot be expected to distribute "indiscriminately" data which he considers a business secret and which his "engineers" worked over for many days fell on deaf ears as far as I. P. is concerned. It will suffice herein to announce that if at any time in the future there arises a need for data relating to the equipments of these dissenting manufacturers, I. P. is prepared either to get it or to follow the identical procedure already marked out.

I. P.'s Moral, Legal Right

One dealer contributed his views to the symposium, not directly to I. P. but to a dealers' association of which he is a member. He cited the "long years" of effort he had expended in building up the "sales value" of a certain unit of sound equipment, stated that I. P. had no moral or legal right to demolish at one stroke the good will thus laboriously built up, and demanded that his association "discipline" I. P. in some manner or other, including, of course, the inevitable withdrawal of advertising

To the credit of the director of this association, it may be said that he promptly replied to this dealer, stating that he not only thought that I. P. was wholly within its rights in protecting the interests of its readers but that I P. was "obligated" to do so. Moreover, he stated, he personally was fully in accord with the policy of full data relative to any unit designed to withstand the daily rigors of projection room operation.

Now, it certainly is not the function of I. P. to harass legitimate manufacturers and dealers. Quite the contrary is true: I. P. is strongly biased in favor of more and better equipment. Still, I. P.'s first duty is not to the manufacturer, who advertises, but to the projectionist, who makes possible the existence of this journal in which manufacturers may advertise.

It is unfortunate that the aforementioned supply dealer did not elect to

(*Continued at foot of next page*)

Disapproved Equipment

REPEATED requests for essential operating data having been ignored, I. P. emphatically disapproves the equipment manufactured by, and suggests that the craft withhold its co-operation from, the following company:

Cincinnati Time Recorder Co.

(*Sound Reproducing Equipment*)

There should be no "mystery" surrounding equipment intended to withstand the rigors of projection room operation. I. P. disapproves of such policies and, naturally of the equipment sold thereunder. "Mystery" equipments are unworthy of craft favor and should be kept at the factory for the individual experimentation and amusement of their manufacturers.

Editorial (*Continued from preceding page*)

in such an undertaking, otherwise the venture will do the motion picture more harm than good. The reaction to the last all-color feature release, "Becky Sharp," was very bad, judged from any angle. Tons of publicity on this release keyed up the public to expect of something really worth while. The result was disappointing; and nobody can tell to what extent this feeling of having been duped carried over in the mind of the public as one of permanent dissatisfaction with motion pictures.

The technicians have accomplished wonders with color and sound in motion pictures. Maybe the next color release will be eminently satisfactory. We hope so. But if it is something less than wholly acceptable, color will have been dealt a staggering blow. Let us hope that the producers of the next color feature will impose some degree of restraint upon their publicity men, 'ere the public is again transported to a high place only to be cast down flat on its face.

★ Craft vs. Industrial Unionism Looms as Titanic Labor Battle

By JAMES J. FINN

SERIOUS trouble is brewing within the ranks of the A. F. of L. as a result of the organization by John L. Lewis, president of the United Mine Workers of America, of the Committee for Industrial Organization, the avowed purpose of which is to foster the growth of industrial, as opposed to craft, unionism. Activities of the Lewis group are of more than passing interest to members of the I. A., which has suffered severely through the craft union structure of the Federation.

Recent organizing activities by the Alliance within the motion picture industry, in the course of which no little damage was done to the strength and prestige of the I. B. E. W., one of the foremost craft organizations in the A. F. of L., lend special significance to the action of the latter's Executive Council at its mid-winter meeting in Miami, Florida.

The Council has demanded the dissolution of the Lewis group on the ground that the latter constitutes "a challenge to the supremacy of the A. F. of L." Proceeding further the Council said:

"All available facts and information, correspondence, printed publications and pamphlets relating to the organization, policies and procedure of the Committee for Industrial Organization (the Lewis group) were examined and considered, and, without forming a definite opinion regarding the character, purpose and objective of the committee, the members of the executive council nevertheless find that there is the growing conviction among an ever increasing number of affiliated unions and those outside of the labor movement that the activities of this committee constitute a challenge to the supremacy of, and will ultimately become dual in purpose and character to, the American Federation of Labor."

Lewis Group Defiant

Newspaper reports pictured Lewis as being openly contemptuous of this action by the Federation Council, quoting him as saying:

"The mountain has labored and brought forth a mouse. The Industrial Committee will continue its program. After all the rumblings and convulsions at Miami for a week past, the unorganized workers of the country had a right to expect that the A. F. of L., in its own interest, would extend a sympathetic hand of assistance rather than a churlish denunciation of these organizations in the federation which are trying constructively to help the cause of labor and the common people in this country."

Another Lewis adherent, Charles P. Howard, head of the International Typographical Union, commenting on the Council's demand for dissolution of the Lewis group, said:

"The charge that the Committee is engaged in an illegal or improper activity is entirely unjustified. The A. F. of L. is composed of both industrial and craft unions. Charters have been and are being issued to both types of organization. It is no more illegal or unethical to conduct a campaign for organization upon an industrial basis than it is to promote organization upon a craft basis.

"The charge of the council that the activities of the committee may lead to dual organization or is a challenge to the supremacy of the A. F. of L. is equally unfounded. The work of the committee is educational, to inspire organization of workers in unorganized industries. Not one national, international or local union has been organized or chartered by the committee in opposition to the A. F. of L. or any affiliated union. Unless some group were organized outside the federation, there could not possibly be a dual movement.

"The effort of the committee has been to increase the membership of organizations holding charters issued by the A. F. of L. The appeal to prejudice by charging the committee with engaging in an activity that might result in dual organization does not indicate a disposition to consider and appraise the work of the committee upon its merits but rather to prejudge the committee's program and condemn without fair consideration."

In a typical gesture, the Council appointed three of its members to "confer"

(*Continued on page* 26)

Rubin Again Heads S. M. P. E. Projection Committee

Harry Rubin, director of projection for Paramount Pictures Corp., has again been named chairman of the Projection Practice Committee of the S. M. P. E., for his fifth term within six years. Rubin's appointment is seen as an answer to the request by projectionists that their activities in the Society be directed by a practical projection man.

Rubin's many contributions to the art through the Society are a reflection of his outstanding position in the projection field for the past 25 years. He is generally credited with having developed effect projection work to a point where it added much to the entertainment program of even de-luxe theatres. Modern use of the Magnascope, or giant screen, is another Rubin accomplishment.

Exemplifying to the highest degree the most progressive type of craftsman, Rubin is a credit to the art, to the Society and, most of all, to the craft.

write direct to I. P.; in which event he would have been invited to a complete and wholly unrestrained discussion in these columns and at I. P.'s expense of the merits of his position. Secrecy is no less intolerable relative to an open and frank discussion of such important trade matters than it is when manufacturers refuse to co-operate in supplying necessary operating data. It is to be hoped that this particular dealer, reading these lines, will avail himself of this indirect but none the less sincere, invitation to spread his views upon the record.

For its part, I. P. appreciates the views of those manufacturers whose fears of unfair competition prompt them to be as secretive as possible about the design, construction and operation of their units. Nowhere is unfair competition—whether in snitching another's ideas or in operating on cut-rate prices—more pronounced than in the motion picture projection field. Although this is quite another topic, it may be that it is not altogether disassociated from the subject under discussion. Who knows but that a policy of open discussion on the merits or demerits of given equipments might not in time result in the removal of even this evil?

In announcing the successful termination of this unpleasant incident, which temporarily threatened to assume grave proportions and lead directly into a bitter struggle, I. P. desires to emphasize the fact that the lever which served to tip the scales in favor of the craft was the growing prestige and authority of the craft itself—not the few words which were spread upon these pages. This is a craft triumph, not just a conventional display of the influence of a publication.

As has been repeatedly set forth in these columns, there is no limit to the influence and authority of the craft, provided its strength is directed into the proper channels.

• *Notes From the Supply Field* •

Automatic Visual and Sound Change-Over By Essannay

RIGHT up to the minute is the new combination Sound & Visual Change-Over now being marketed by the Essannay Electric Mfg. Co., 908 South Wabash Ave., Chicago, Ill. Essannay is headed by Larry Strong, a member of Local 110, Chicago.

This new change-over accomplishes the dual task of changing over *both* picture and sound, merely by stepping on the foot switch. It is designed for port mounting, having a 4-inch opening and a double-blade cut-off, thereby cutting the light off in one-half the time required by a single blade job. A particular advantage of this unit is that it effectively blocks out noise from the auditorium through the only openings in the room.

The speed of the change-over is regulated by an adjustment screw, insuring perfect timing between both units. This is an exclusive and patented feature. Figure 1 shows the complete change-over ready for mounting at the port. The legend is:

A—Housing for sound switch
B—Switch for automatic sound changes
C—Picture cut-off blades
D—Knob for manual operation
E—Space for optical glass
F—Speed adjustment screw

Figure 2 shows the change-over with the sound switch cover removed. The proper type switch is provided for any type of sound system. When the projectionist steps upon the foot switch the blades of one change-over open, and the other closes. The action is as follows:

A—Arm mounted on the end of the shaft suporting cut-off blades. As the blade opens, the arm swings over, pushing down the switch blades and making

B—The proper contacts to shift the sound to the second machine and holding these contacts as long as the change-over is open. When the projectionist

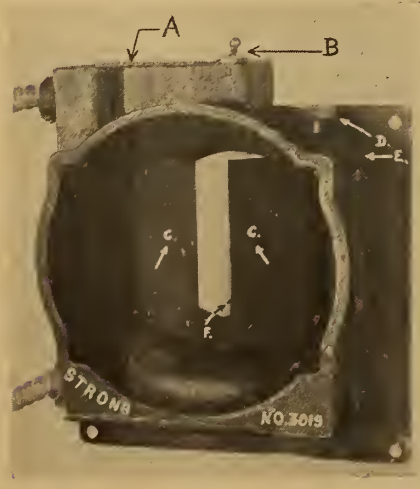


FIGURE 1

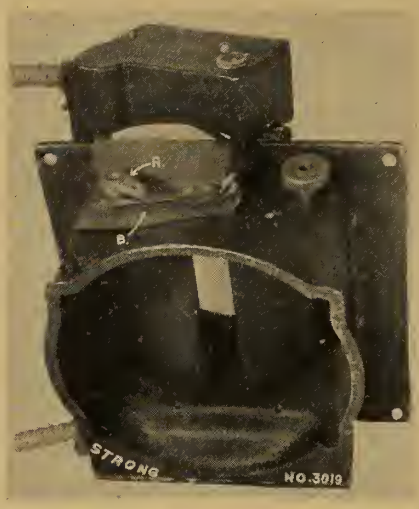


FIGURE 2

shifts to the other machine, the action is reversed, with the blades closing and the arm swinging free of the switch contacts, thus breaking the sound circuit.

This method insures absolutely simultaneous change-over of both sound and picture. The accompanying pictures show an Essannay "Special" model so equipped, but Essannay advises that this unit can be supplied for all Essannay change-overs and for all types of sound systems.

New Supreme Model 491 Theatre Set Tester

Supreme Instruments Corp., Greenwood, Miss., announces general distribution of their new Model 491 theatre, p. a. and radio analyzer, which supersedes their Model 391. The Model 491 is a newly developed instrument designed expressly to meet the needs of theatre projectionists and p. a. engineers.

Rotary switches, completely internal resistance-measuring power supply, both point-to-point and selective analysis (socket) testing methods, and multi-range meter (including 6 d.b. ranges)—all combine to make the new Model 491 Supreme analyzer a most unique test instrument. Full details available from Supreme.

S. M. P. E. EXECUTIVE CHANGES

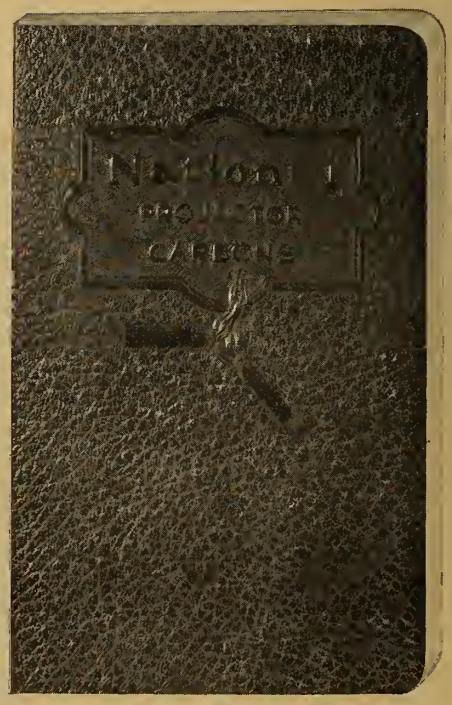
S. K. Wolf has been appointed executive vice-president of the S.M.P.E. The change in the executive line up became necessary with the transfer of Homer G. Tasker, president to the West Coast. Emery Huse, former executive vice-president resigned from that office and was appointed a member of the board of directors. Mr. Wolf is with Erpi.

New National Carbon Projection Handbook Now Available to All Projectionists

PROJECTIONISTS will welcome the new edition of the Carbon Handbook which has just been announced by the National Carbon Co. This book, just off the press, is a revised and enlarged third edition of this familiar work, which has enjoyed wide popularity among projectionists for its wealth of practical operating data.

The new edition not only covers in detail the operating characteristics of all of the older types of projector arcs but in addition devotes considerable space to the new Suprex direct-current, non-rotating, high-intensity arc, as well as the new high-intensity, alternating-current arc. Valuable tables and easy methods of computation again are a feature of the book. I. P. recommends this volume as a valuable aid to practical projection work.

Copies of this new Handbook will be supplied without charge by the National Carbon Co. It is suggested that requests for copies include the name of the theatre or amusement organization with which the projectionist is identified. Readers of I. P. may either write direct to National Carbon Co., P. O. Box 6087, Cleveland, Ohio (mentioning I. P.) or use the convenient coupon appearing on page 3 of this issue.



Free Supreme Booklet On Complete Tube Testing

To those interested in test instruments design, the supreme Instruments Corp. of Greenwood, Miss., manufacturers of test instruments, offers a 16-page booklet, "The Evolution of Tube Testing." This booklet is crammed full of technical data on various types of tube testing circuits and is supplemented by numerous diagrams. The reader is taken through the thousands of tests necessary to the design of a commercially acceptable tube tester much the same as if he were actually present in the laboratory during the preceding years of patient research.

This is really the first time that such information has been made available generally. You can obtain a free copy by writing Supreme, mentioning this publication.

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A publicity release states that many noted lecturers are using the Bell & Howell 1000-watt 16 mm. auditorium projector in "large auditoriums." Proceeding the release states: "Besides affording large-sized (up to 20 feet wide), brilliant pictures, the projector can use 1600-foot reels and thus show a full hour of pictures without change of reels. A trained operator is not necessary: start the projector and it will run right along until the entire 1600 feet are projected."

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News Notes

Arthur Martens has been elected president of L. U. 650 (Westchester County, N. Y.), completing an unbroken tenure of office since the unit was chartered in 1927. Richard Hayes, named business manager, is a past exalted ruler of Elks of White Plains, N. Y.

• • •

Newark, N. J., L. U. 244 is now operating under a receiver named by the court as a result of an action instituted by "junior members" (old permit men) who alleged they were discriminated against. Deposed officers include Louis Kaufman, b. a., and Louis Oppenheimer, secretary.

• • •

Thad Barrows and James F. Burke have again been elected president and business representative, respectively, of Boston L. U. 182. Other officers: B. McGaffigan, vice-president; Louis Pirvano, Joseph Nuzzolo and James Gibbons, executive board. Messrs. Barrows, Burke and McGaffigan were named I. A. convention delegates.

• • •

C. K. Peters, Jr., bustling secretary of Paris, Texas, L. U. 548, proudly announces the result of more bustling in the person of C. K. Peters, III. Weighing 9½ pounds at the post, C. K., III, is reported to be strictly Union Made. Red Rupard (Dallas) Eddie Miller (Houston) and Harry Sherman please note.

• • •

Jurisdiction over the radio industry was awarded to the I. B. E. W. at the recent meeting of the A. F. of L. Executive Council in Miami, in the face of demands by present radio organizations for a "vertical" set-up in the industry, failing which they would withdraw from the Federation. I. A. men will recall resolution introduced at Louisville convention requesting assent to organize these workers for I. A., on the theory that I. A. should control entire amusement field.

CRAFT vs. INDUSTRIAL WAR AMONG A. F. OF L. UNIONS

(*Continued from page* 23)

with the Lewis group: Messrs. Harrison, Weber and Bugniazet, the last two representatives of the Musicians and Electrical Workers, respectively, and dyed-in-the-wool craft union supporters. That these "conferences" will result in settlement of the difficulty is seriously to be doubted, since Lewis recently resigned as a member of the Executive Council in protest against the action of the last Convention in upholding the craft union idea.

It must be admitted, of course, that Lewis himself is not generally regarded as a knight in shining armor sallying forth to rout the forces of evil, his record in the labor movement to date being suggestive of something less than a candidate for canonization on the score of particularly saintly qualities. Yet, those who favor the industrial union advocated by Lewis feel that he may as well lead the movement as anybody else.

Craft Group Dominate A. F. of L.

The action of the last A. F. of L. Convention in disapproving the industrial form is significant only in proving vise-

James Brennan, president of N. Y. stagehands and I. A. vice-president, is credited with statement that his men will take over sound projection system servicing "as soon as he is ready." Spread of work among stagehands is viewed as an effort to relieve acute unemployment in ranks of that craft.

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like grip of craft unionists upon the Federation, which for years has been dominated by the same group of laborites, all of whom have their roots in the outmoded craft union. Had Lewis been suspected of industrial union leanings, he would never have been elected to the Council.

President Green of the A. F. of L. is helpless to take any action before it is okayed by the leaders of the large craft unions within the Federation, notably the Carpenters, Teamsters, and the Building Trades group, among the latter being the Electrical Workers. In fact, certain well-informed quarters credit Hutchinson, leader of the Carpenters, as having been the power behind the A. F. of L. presidential throne for years. However accurate this surmise may be, it is no secret that anybody wishing to do anything or get anywhere in the Federation had to "see Hutchinson" and get his O.K.

A most interesting commentary on A. F. of L. structure was made by Professor Sumner H. Schlicter, Harvard professor, whose articles on the "Philosophic Background of Unions" induced much favorable comment among I. P. readers when printed herein. Said Professor Schlicter:

"Within these few months (late 1933) the Federation reached a new peak in membership. Most of this growth it will probably retain. How much further and how fast it will go depends on the success it has in working out a form of organization satisfactory to employers, some employes and existing trade unions.

"There is at present a strong demand on the part of employers and the rank and file of newly organized wage earners for the industrial form of organization. This cuts across the A. F. of L. at some points. Until the resulting complications are ironed out, growth in the Federation membership is likely to be retarded.

"The A. F. of L. threw away a great opportunity to organize the working people during the time of the NRA codes. That is an unfair statement, perhaps, but after all, the A. F. of L. does not exist for organizing but rather for the preservation of the autonomy of constituent unions to prevent them from being bossed and overwhelmed by outside organizations."

Impartial observers view the present structural troubles of the A. F. of L. as the inevitable result of its shilly-shallying tactics over a period of years. Jurisdictional troubles involving two or more fairly strong internationals never could be settled by the parent body, which always managed to duck the issue by referring the dispute to some impotent committee or by prevailing upon the weaker international president to forego a showdown for the "good and welfare of the Federation." These tactics may have served to prevent immediate disruption within the organization and avoid a bitter fight, but they proved anew the truth of the old adage that no problem is settled until it is settled right.

On this basis the Federation was able to move along without serious trouble for many years; but without the aid of a safety valve such as an open blow-off of steam and a good open-handed fight, the Federation was cramming up underground the natural gas which today has burst through the surface and now threatens to do irreparable harm to the organization.

Jurisdictional fights involving weak internationals, whose rights some large unit insisted upon gobbling up, were settled immediately, of course, by the simple process of stripping the weaker units and throwing their remains to the larger groups whose appetites for such provender grew ever more expansive.

Indicative of Federation policies in this respect was the course of the jurisdictional battles relating to the Brewery Workers and the I. A. T. S. E. at the 1933 Convention in Washington. The defenceless Brewery Workers were drawn and quartered and their rights parcelled out indiscriminately to the Teamsters and the Engineers. The Federation hesitated a bit on the score of the I. A. dismemberment, however, because of the smell certain to arise through partition of a unit so well known and so susceptible of publicity as is any motion picture affiliate, and also because of the known ability of the I. A. to yell long and loud and thus attract highly unfavorable publicity to the Federation at a time when the code battles were in progress and the A. F. of L. was daily being pictured as one big family of happy workers who were striv-

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ing only for "justice" and a "decent wage."

However, the Federation has never quite been able to live down the stench attendant upon the rape of the I. A. in the West Coast studios by the I. B. E. W., when the latter actually "ratted" upon a sister affiliate in the Federation by taking the jobs of striking I. A. members. Repeated requests to the A. F. of L. anent this procedure got nowhere, because the Federation was intent not upon meting out justice to the I. A. but rather upon keeping in the good graces of the powerful Building Trades group, of which the I. B. E. W. was a prominent unit. "Scabbing" as commonly practiced by non-affiliated groups invariably brings expressions of horror from the Federation; but the rape of the I. A. by the I. B. E. W. was unproductive of so much as a raised eyebrow among Federation stalwarts.

To return to the I. A. interest in current Lewis activities, it is remembered that President George E. Browne of the I. A. bumped into the outstanding exponents of the craft union idea in his recent successful tussle to regain the motion picture studios for the I. A. Just what peculiar power Browne possesses, or just what means he employed to bury forever as far as I. A. is concerned the hoodoo of craft unionism, is not known; but it will suffice to cite the general opinion on all sides that Browne met these craft union lions in their own den, gave them a thorough shellacking and emerged with practically everything but his opponents' charters.

Here was a terrific jolt to the craft unionists. What the A. F. of L. Executive Council thinks about this piece of business is not known, but it is safe to say that they hardly relish the outcome of the matter. It is equally safe to say that Browne, judged by his attitude throughout the studio affair, is completely indifferent to anybody's opinion of the job.

I. A. Course Doubtful

The newspapers were particularly anxious to associate the I. A. with the Lewis group following the studio settlement, and in several instances printed stories to the effect that Browne was proceeding with the blessing of Lewis. No more effective denial of these stories is available than the fact that at the last A. F. of L. Convention the I. A. several times voted against the Lewis group.

The outcome of the present strife within the Federation is hard to forecast; but Browne's course to date indicates that the I. A. likely will refuse to line up definitely on either side, being content to strengthen its own lines without regard to the trend of the Federation as a whole toward either craft or industrial unionism. Should the present difficulty lead up to a wide-open battle in which the opposing lines were sharply defined and tightly drawn, however, it appears likely that the I. A. will have to take a definite stand in the matter. The answer to which contingency lies in the future.

TELEVISION AND THE MOTION PICTURE THEATRE

(*Continued from page* 11)

(except for unusual "pageant" subjects and the like).

Taking the last-mentioned type of television picture, and assuming a flickerless transmission, it is found that the required "sidebands" produced by the picture modulation of the ultra-short-wave carrier have a width of the order of 1.5 megacycles (or about 150 times the frequency band required for high-fidelity 10,000-cycle sound reproduction)!

Co-operation Between Arts

Passing to the subject of topic (*c*) aforementioned, namely the contacts and cooperative possibilities between motion pictures and television, it is clear from the beginning that there can be a close connection, if such is desired.

A person viewing a small picture in motion with synchronized sound might find some difficulty in knowing whether he was viewing a sound motion picture projected from film or a television-telephone broadcasting reception. He might be even more puzzled if the subject matter were, say, a newsreel used to control the television-telephone transmitter, an entirely feasible procedure.

Obviously the technique of producing a television-telephone broadcast program will closely resemble that of producing a sound motion picture. Methods of costuming, make-up, script construction, "camera" technique, sound pick-up, set

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construction and illumination, and the like may well be similar in the two fields, though probably not with the same degree of elaborateness in the case of television.

One Sharp Distinction

There is one respect in which they will necessarily differ if an original performance (rather than a film record) is broadcast. This is a limitation of television-telephone broadcastings, namely, the possibility of only one "take," to wit, that one which is broadcast. In motion picture production, any reasonable number of takes may be made; not so in broadcasting where the radio wave irrevocably carries the selected performance to all homes.

As has been mentioned, sound motion picture films may be excellent subject matter for programs from some stations, and may even afford one means of syndicating programs in somewhat the same way electrical transcription (phonograph disc records of programs) are now used.

It is not believed, however, that television-telephone syndication operation will be fully satisfactory unless there are also actual interconnecting wires or radio networks between the outlet stations, since there will be many occasions —for example, a speech by the President, a political convention, an evening prize fight, and the like—where the public can hardly be completely satisfied by any radio performance which does not take place at the same time as the actual event. Indeed, it must be admitted that this is one of the outstanding capabilities of radio broadcasting which it would be unwise to discard.

Many persons are convinced that television broadcasting will whet the appetite of the "lookers," and, so far from diminishing the theatre audience, will build it up by arousing interest among children and adults alike in the probably more elaborate and highly developed offerings of the theatre. It is also clear that the theatre can, to a considerable extent, utilize radio advertising by television-telephony—for example, by the sponsored transmission of trailers of one sort or another. Radio will then offer the theatre a remarkably effective method of submitting its "sample line" to the public.

This brings us to topic (*d*), namely, the possible effect on the theatre of the widespread acceptance of television-telephone broadcasting. We are inclined to be definitely optimistic as to this. The argument that television broadcasting may keep people out of the theatre does not appear to have much weight. Consider, for example, the following controlling principles:

Effect Upon Existing Theatre

(*a*) Intrinsically the home is certainly not so good a showplace as the theatre. It is more difficult to suppress natural and man-made noise in the home; home manners tend to be more "free and easy" than is desirable for showmanlike presentations; the problem of setting up the theatre in the home is far from simple when furniture must be moved to get a good view of the screen and the home folks and guests gotten into the corresponding convenient viewing positions; and home lighting is rarely as controllable or suitable for picture presentation as is the case for the theatre.

Indeed, the customary surroundings of the home are not especially favorable for the creation of a world of illusion which has always been the successful function of the theatre. It is not maintained that there will not be value and interest to the home presentation; quite the contrary. It is stressed, however, that the home has certain disadvantages of long standing for program presentation which cannot be disregarded.

(*b*) Conversely, the theatre has a number of definite and inherent advantages as a showplace. It arouses the interest of the audience by heavy theatre advertising in the press, by the play-up of the "fan magazines," and by other

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exploitation methods known to skillful managers, thus creating the proper mood of pleasurable anticipation in the prospective audience. The marquee and lobby of the theatre, ablaze with light and motion, and with attractive photographs of selected scenes from the picture displayed within, further attract the audience.

Within the theatre, suave but real discipline is maintained by the ushers—a task calculated to daunt the bravest in the home. Furthermore, the price of admission, exacted at the box office just before entry, is a powerful deterrent to lack of interest on the part of the audience. It takes a poor picture indeed to force the audience to cheat itself by inattention.

The program in the theatre generally is a well-planned arrangement of elements which fit together and which take as long as may reasonably be required to get the desired effect In broadcasting, because of certain administrational problems, the successive elements of the evening program are coordinated only with the utmost difficulty, if at all, and necessarily run in 15- or 30-minute slices—a not always convenient or artistic time. At the present time, with the occasional obnoxious exception of excessively prolonged or unduly fulsome blurbs relative to approaching attractions, the theatre screen is practically free from advertising; whereas advertising and the sponsored program are at present the commercial basis of the maintenance of broadcasting. The elaborate perfection of some feature pictures will be duplicable only rarely within the necessary economic limits of broadcasting.

To the preceding factors may be added the air conditioning of many theatres and the attempts at comfortable theatre seating, lighting, and the like. All in all, theatres may be expected to be attractive places to the public regardless of other entertainment media.

(*c*) If we consider some deep-seated characteristics of human beings, it becomes further evident that the theatre has certain ways of holding its own alongside of a successfully developed television-telephone broadcasting set-up. People are interested in change. If they are in the home a good deal—and most of them are—they naturally will seek some of their entertainment and diversion elsewhere. The remarkable vogue of the automobile in which people wander rather aimlessly from one place to another largely for the sake of motion is a case in point.

Also, people are gregarious and somehow seem to have their emotional responses enhanced by crowd enthusiasm. One can readily observe this at sporting events, political rallies, revivalist meetings, and other occasions where collective enthusiasms or emotional responses are developed. Then, too, people are distinctly conservative in their pleasures and not prone to abandon hastily anything (the theatre) which for a number of centuries has proven a trusty source of entertainment and amusement.

It seems most likely that the theatre and television-telephone broadcasting will each be successful fields in their own domain, and that *the theatre need not be unduly apprehensive over the advent of television.*

Task Confronting the Theatre

Nevertheless, it must in all candor be emphasized that film producers and theatre managers must not be merely content with past achievements. To hold their position of leadership in their own chosen fields, they must steadily improve and frequently experiment. It is necessary that they shall use whatever good ideas or methods may spring from television broadcasting, for example. *A merely superior or indifferent attitude toward new arts or toward improvements in their own older art may prove a first-class passport to diminished public acceptance and ultimate oblivion.*

Of necessity the motion picture industry must also fully avail itself of all the skilled advice and guidance which it can secure only from the relatively few experts who are acquainted with both the theatre and broadcasting. Few things would be more dangerous to the motion picture industry than dependence on certain of the pathetically absurd mistatements which have been widely circulated by certain of its members.

However, given its natural advantages, a forward-looking attitude, real initiative, and careful planning, there appears to be little doubt that the motion picture theatre can hold an enviable position of public acceptance and resulting prosperity in the future as in the past.

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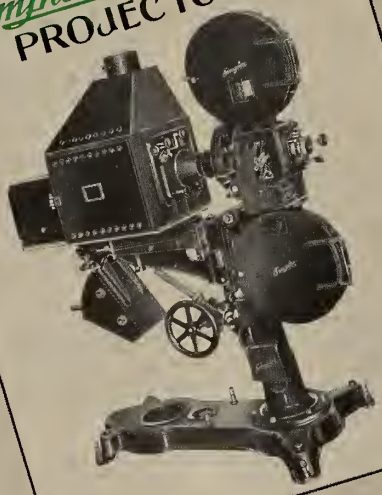
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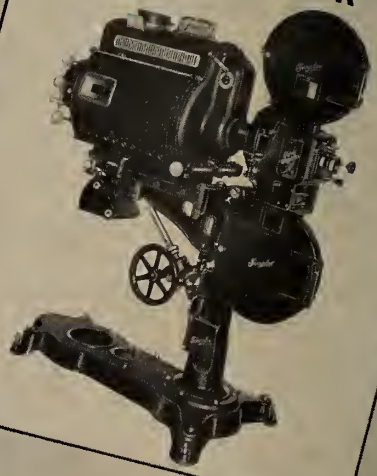
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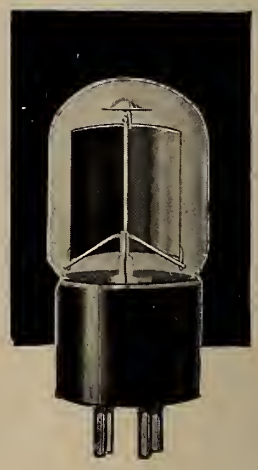
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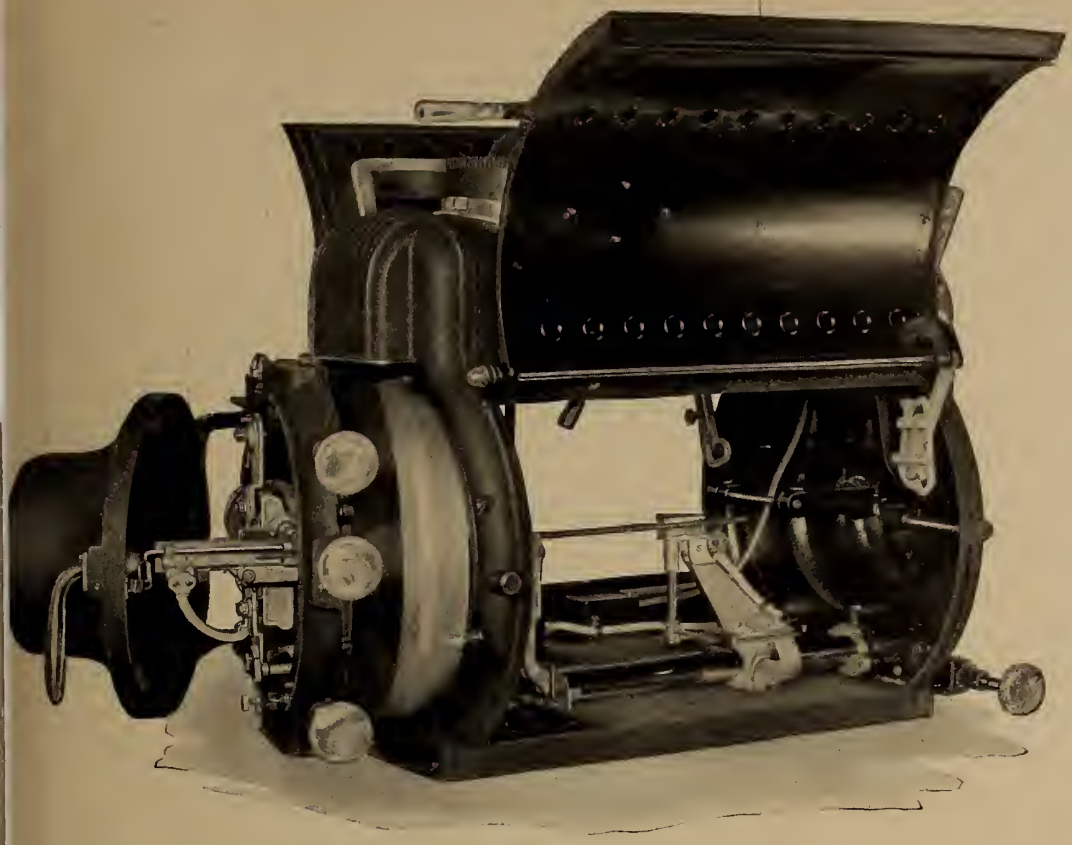
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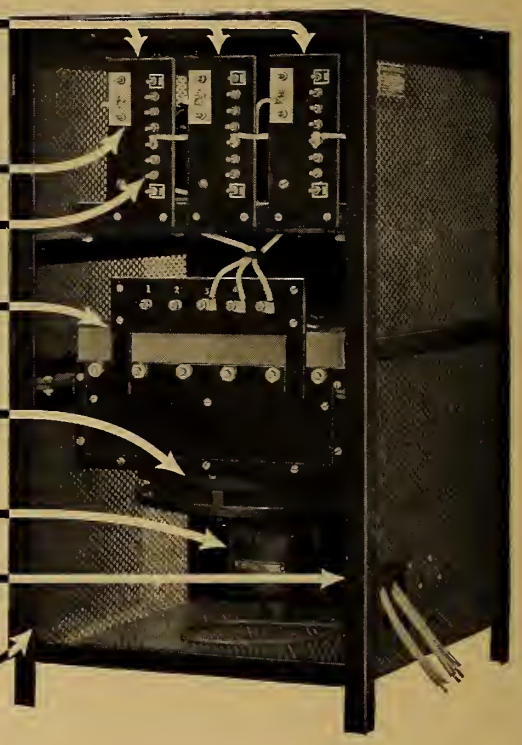
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International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

Volume 10 FEBRUARY 1936 *Number 2*

Index and Monthly Chat 5

Function and Application of Sound System Analyzer Equipment 7
A. C. SCHROEDER

Inept Handling of Double Reel Inspires Charge that Unions Killed Proposal 10

Electrics Make Drastic Rate Slash to Combat Union Service; Defense Cited 13

Sources of D. C. Supply for the Suprex H. I. Arc 14
C. C. DASH

A Rectifier Manufacturer Dissents 17
J. K. ELDERKIN

Cleveland Plan Embraces Emergency and Engineering Service 18
VICTOR WELMAN

The Story Behind the Story of L. U. 160 Theatre Service .. 19
JAMES J. FINN

The Editorial Page 21

Amplifier Characteristics and Methods of Coupling 22
M. J. YAHR

Letters to the Editor 23

News of the Month 24

RCA Ultra-Violet Recording a Notable Advance in the Art .. 25

News Notes

Technical Hints

Miscellaneous Items

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MONTHLY CHAT

ORACLES are popping up behind banquet tables the country over and shoveling out their opinions on television. Five speeches by noted humans on television within the past month or so were concerned with the relationship existing between this new art and motion pictures—and all five talkers forgot to credit Dr. A. N. Goldsmith with so little as a footnote in helping to shape their opinions. Of course, I. P. readers have long enjoyed the "inside" from the Doctor and need not attend banquets to understand properly this "marriage" of the arts.

FOUR thousand miles of traveling by this writer during the past month uncovered a resurgence of educational activity by the craft. Whether having its roots in the sound system servicing scare or not is relatively unimportant by comparison with the important fact that the craft has again knuckled down to essential business—its *only* business, in fact.

SUPREX arc adherents are running away with themselves when they advocate larger carbons and higher amperages for existing lamp designs. The terrific promotional campaign accorded this arc sold some of the boys the idea that here was the perfect light source, the final word in arc lamps for *all* theatres. Such is not the case, however good the arc may be: the Suprex arc was designed to do a certain type of job in theatres of a certain classification. Of this topic more anon.

ON THE social significance calendar, we observe that our "mirror of life" movies put on film such affronts to Labor (and to one's intelligence) as "Riffraff" (so aptly titled) but they ban such works as "It Can't Happen Here," by Sinclair Lewis, for fear of offending some dictatorial monkey overseas. It can and evidently does happen here.

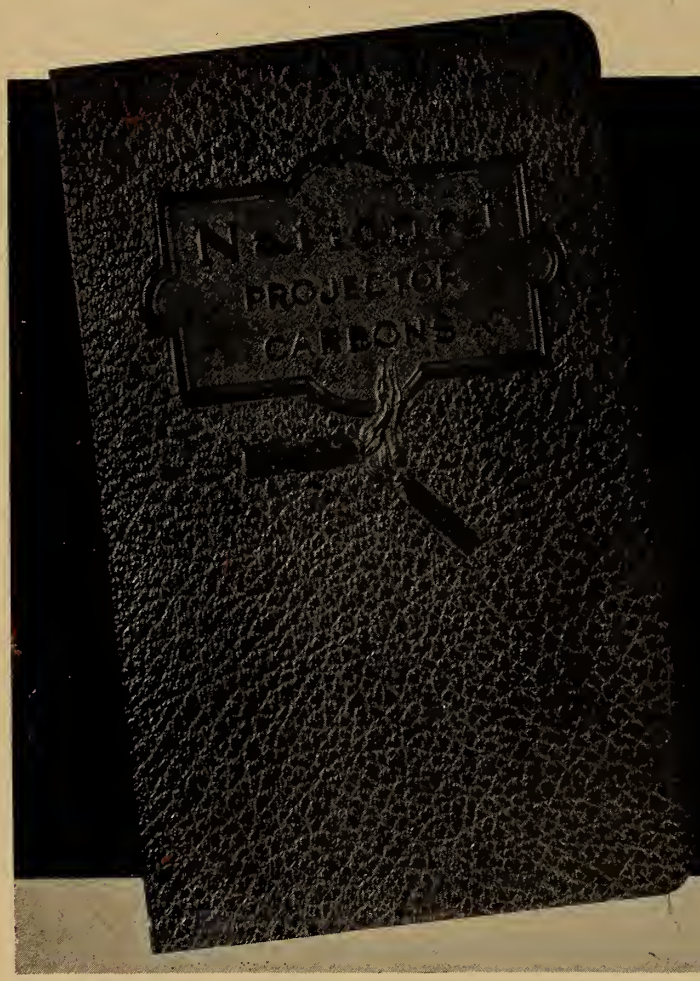
CONTRIBUTIONS direct from the man alongside the projector to this publication continue to show a healthy increase, official note of which trend is recorded here. Personally, we prefer one comment from the practical projectionist to six "papers" which reflect the mental meanderings of so-called engineers.

WHO in the technical end of pictures didn't say that selenium cells just wouldn't do for sound pictures? Practically everybody said so. Still, Warners are using nothing else but selenium in their United Reproducer Corp. theatre sound outfits, many installations of which have been made in Warner houses.

How many readers recall the technical dope on selenium cells which was published herein?

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INTERNATIONAL PROJECTIONIST

VOLUME X NUMBER 2

FEBRUARY 1936

Function and Application of Sound System Analyzer Equipment

By A. C. SCHROEDER

MEMBER, LOCAL UNION 150, LOS ANGELES, CALIF.

PROJECTIONSTS are becoming analyzer conscious, intensely so, and are asking all sorts of questions regarding them. For months I have been asked about the different instruments—what they will do, what this, that and the other one will do; or is this one worth more than some other one?

Any of the good analyzers will undoubtedly give satisfactory service. What to recommend to the house along this line will have to be decided by you yourself. Do I hear you say, "Well, you're a big help"? Let's see what can be done about it.

Correct Usage Important

When a theatre buys an analyzer, the thing is valueless unless you, the projectionist learn how to use it. After you do learn, you are in a position to know which one you want, so the thing to do is to learn what these units are for, how they work and *how to interpret the results*. To tell all about this is a big order for one article so in this installment we will just cover the high spots.

The analyzer is a device whereby the circuits are extended from the tube sockets to one or more sockets on the analyzer, and to one or more meters. The extension is made by putting a plug into the socket in the amplifier. The plug is on one end of a cable, the other end going to the analyzer sockets.

Adapters are furnished so that the plug can be inserted in sockets made for tubes having from four prongs up to those having eight prongs, and adapters for the ERPI 211 and 242 type tubes may be had. Instead of four wires in the cable, as in Fig. 1, the cable will have eight wires, and the plug will have seven or eight prongs. Fig. 2 shows how the sockets in the analyzer are connected to the cable. The wires extending to the right represent the cable, at the other end of which is the plug. The gadget on the end of the eighth wire is a clip for the terminal at the top of some tubes.

Diagrams referred to herein appear on the next page

Meter Equipment

Very often an analyzer has only one meter and is connected to the various circuits either by switching or by plugging a pair of test leads into different jacks. The meter is connected through a number of switches so that multiplier resistors of various values can be used in series with the meter for voltage tests, and so that shunt resistors may be used for different ranges of current measurements. A copper-oxide rectifier is included and allows the d.c. meter to measure a.c. voltages or currents. This is used because the ordinary a.c. meter draws too much current for testing sound equipment and radios.

Although the cable has eight or nine

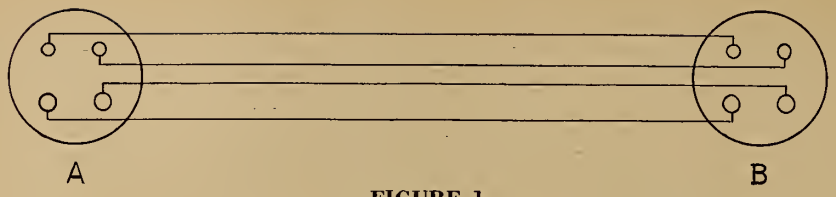


FIGURE 1

wires, only as many are used as there are prongs on the tube being tested, or one more if it has a terminal on the top, as do the 262-A, 224 and some other tubes. The plug at the end of the cable is put into an adapter having as many prongs as this same tube has. With the four-prong adapter on the plug, we place it in a socket—say, in the 49 amplifier. The tube we took out of this socket is placed in the corresponding socket in the analyzer.

The four socket contacts in the amplifier make connections to the four prongs of the adapter, while the other ends of these prongs connect to four of the prongs in the plug. All the other prongs in the plug go into "blind" holes in the adapter, and the wires connected to these plugs are not used in this case. A similar condition exists at the analyzer, where the four wires go to the socket in which we have placed the tube, but these wires also go to all the other sockets, as in Fig. 2. The other wires go to some or all of the remaining sockets.

At A in Fig. 1 we see the socket in the analyzer; B is the plug, and the two are connected by the cable. In this drawing there is nothing else shown, although, actually, arrangements are made to open some or all of these connecting wires; also, other wires are hooked to them for different purposes. Notice that the main idea is to provide a means of placing the tube in the analyzer and yet have it connected just as though it were still in the amplifier. Having accomplished this, we are in a position to manipulate these circuits at will, something that could not be conveniently done in the amplifier itself.

Elementary Analyzer Form

Figure 3 shows the circuit of a very elementary form of analyzer, which was kept as simple as possible in order that the principle of the unit would become clear. It is easy to trace these circuits. In an actual analyzer there is a maze of wiring that makes one think of a telephone switchboard. While the average analyzer that you might buy operates about the same as the one shown in Fig. 3, unless you were quite familiar with the circuits, it would serve only to confuse matters.

Wires Nos. 1, 2, 3 and 4 are in the cable, the end of which, extending to the right, having been plugged into the 49 amplifier. Tracing No. 4 to the left and then down to A, the socket in which the 264 tube has been placed, it is seen that this wire connects to one of the large prongs, a filament prong, and therefore carries filament current. Following this wire in the upward direction, it leads to B, a switch which makes connections allowing voltage or current measurements.

At the moment, B is in the voltage

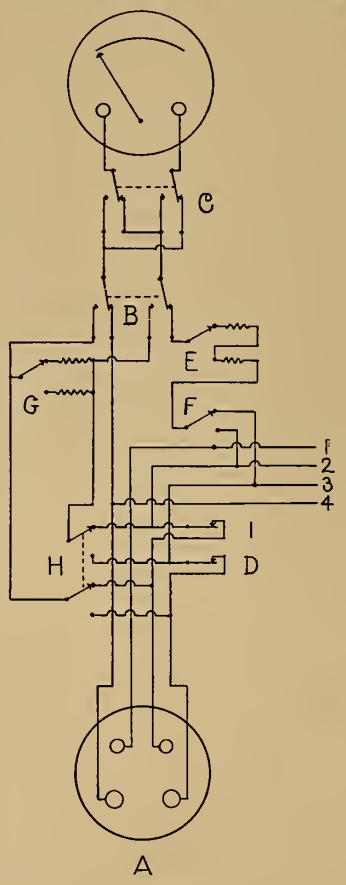


FIGURE 3

position, so the circuit goes up to C, a polarity switch. If the meter reads in the correct direction, all is well. Should it read the wrong way, C is thrown in the other direction, and by studying this part of the diagram it can be seen that the meter will now read as it should. As far as wire No. 4 is concerned, our circuit has been completed to make a voltage reading. This is the negative filament wire, and is left just as it is for all voltage measurements.

Number 3 is the positive filament wire, and makes connection to that contact in the amplifier. We follow this wire to the left and down through switch D—which we disregard for the present, as it is closed—then to A, to the other filament contact.

To read the filament voltage we now have to bring this wire up to the other terminal of the meter. Following No. 3 up, it goes to one of three points of the switch F. The knob has been turned so that contact has been made with this point. From here connection is made to two resistances in series, with taps going to two points on switch E. These resistances are multipliers. E is in the high-voltage position. To read filament voltage we need the low range, so E is moved to the lower contact. The circuit goes through B and C (which were explained in connection with the negative filament wire) and then to the meter.

So far we have made connections to a tube that had been removed from an amplifier and placed in the analyzer. Also, a meter has been connected across the two filament wires, a multiplier resistance has been connected in series with it, and a means has been provided for correcting the polarity. This has all been done in less time than was required for the explanation.

Multiplier Resistances

In the actual analyzer there will be four or more multiplier resistances and as many positions on E. E may be combined with G and B, or B may be combined with F and H. E, F, G and H will have more positions, and there will be more of the switches shown at D and I, or they may be combined with H. Of course, the cable also has more wires.

Number 2 is the plate wire, and the method of procedure will be similar to that for measuring filament voltage. F is moved to the point connected to No. 2; E is already in the high-voltage position, but must be checked to make sure, as the meter would be ruined if the plate

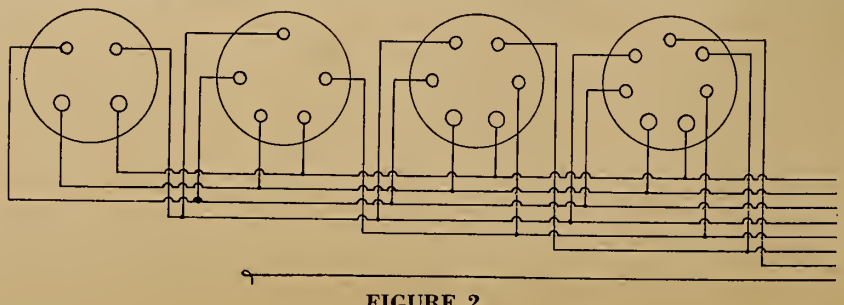


FIGURE 2

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voltage were to be read while E was in the low-voltage position.

There remains the grid voltage to be read. If the tube had more prongs, and we had a regular analyzer, F would be turned to the position connected to the element of which the voltage is to be taken, and E would be turned to the proper range.

In connection with current readings, B is moved to the left. It is seen that this disconnects the negative filament wire. No means is provided in this analyzer for reading current in this wire, but this is the same as the current in the positive wire (practically).

Starting with No. 3 wire, follow this down to switch D. At D this wire branches off and goes left to a part of switch H, which selects the circuit that will be connected to the meter in order to read the current. Moving H down to make contact with the lower point, we then follow the wire from the blade of the switch up to two resistances. For the moment we will not go through the resistance, but will follow the wire up to B, which we now move to the left, and so on up to the meter through C. The dotted lines in C, B and H represent an insulated bar, moving both blades of the switch at the same time.

Following the wire from the other terminal of the meter, we again go through C, then B, and down to G, which connects to the other end of the resistances that we left on our way up to the meter. You can see that one of these resistances is connected across the meter, which is why it is called a shunt. It shunts some of the current around the meter. G must be moved to the correct shunt to read filament current (which in this case is 300 mils) so the meter scale might read 500 mils, or ½ amp.

From the blade of G we trace down to the lower part of H, which is already in the right position, since we had moved it there in following the circuit up to the meter. From the lower contact of H the circuit goes to the wire connecting the lower part of D and down to the filament of the tube. This has placed the meter in the filament circuit, placed the proper shunt around the meter, and all we have to do now is to push down the button on D and read the filament current. You will notice that when D is closed it short-circuits the part of the wiring going to the left and up to the shunts and the meter.

Reading Plate Current

You should now be able to follow the circuits used in reading the plate current. No. 2 is the plate wire. We first see that B is to the left. Then G is turned to the correct position. H is now moved to make contact with the upper points of the switch. Pressing on the button of switch I now allows us to read the plate current. Should this be in the wrong direction, throw C the other way and then read the current.

This circuit was drawn to explain an analyzer, and is not a practical working device, there being certain elements in it that would not be so good if built up exactly as shown.

The foregoing gives a fair idea of the whys and wherefors of the analyzer. Next month we will discuss how to interpret the results of the readings obtained, and possibly some of the other uses to which these interesting instruments are put. To those readers who are familiar with this sort of equipment it may seem that some important points have been overlooked, but these points will be developed in future installments.

(To be Continued)

Inept Handling of Double Reel Inspires Charge That Unions Killed Proposal

NOTHING is ever settled until it is settled right is an old adage that is applicable with special emphasis to the present muddled double-reel situation. I. P. has never voiced its opinion of the fumbling and fussing and futile tugging around that has marked the progress (?) of this matter to date, because to have done so might have occasioned a measure of ill feeling which would have done neither the craft nor the reel's sponsors any good.

True, I. P. did seize upon the double-reel fracas to hand out some rather severe lectures to the craft on the score of its complete disorganization and sham pretense of being a coordinated national unit on technical matters — but these slams the craft absorbed partly because I. P. handed them out (the privileges of an old and faithful dog) and partly because the criticism was merited.

From the very start I. P. made every effort to reconcile the differences existing between the producer-exhibitor interests and the craft on this project—despite the necessity for running counter to the known wishes of not a few of the larger and more powerful projectionist units in the Alliance. I. P. played out the game and absorbed whatever jolts were handed it by these aforementioned units, its one concern being to avert that situation wherein the double-reel sponsors could point a finger at the Unions and charge that the latter had killed the new standard.

Harsh words these, but entirely justifiable now that the game has been played out—that is, as far as I. P. is concerned. The proposed reel standard, having been the victim of numerous postponements (the latest advance being from April 1 to August 1, this year) is now described as a dead horse that was "killed by the Unions"—precisely the charge I. P. anticipated and made every effort to squelch. The craft having absorbed in a vertical position such criticism as was handed out on this topic, let's review briefly the facts relative to the development of this enterprise and find out whether the other side can also take it.

Last September in the New York offices of the M.P.P.D.A. (Hays group) there was held a meeting of the alleged best minds of the distribution exchanges) and projection groups. The producers' interests were looked after by Mr. Gordon S. Mitchell, representing the Academy of M. P. Arts & Sciences, sponsor of the proposed change, and Arthur Dickinson of the Hays office. This writer attended the session.

The conference generated no little gab about specifications—reels, shipping cases, exchange vaults, express charges, etc.—and it early became evident that the representatives of at least three of the major distributors had no particular fancy for the longer reel standard, if in fact they were not actually opposed to it. Universal still is openly opposed to the longer reel.

Official Opinion Ignored

Anticipating that the opposition of the distributors themselves might ultimately defeat the project, and sensing that nobody was willing to introduce the one topic that everybody present was thinking about, this writer expressed the opinion that before proceeding with technical and financial questions it might be well if the sponsors of the reel sought to ascertain the feeling of the organized projectionist craft toward the longer reel. This opinion included the flat statement that there were several large projectionist units known to be opposed to double reels, and that since the success or failure of the proposed standard in the last analysis rested largely with the projectionist craft, an effort should be made *in advance* of any actual work on the project to obtain an *official* expression of opinion from the Alliance.

Everybody seemed to think that this was a very fine idea; and projectionist participation in the meeting terminated shortly thereafter.

To this, I. P. knows of no effort

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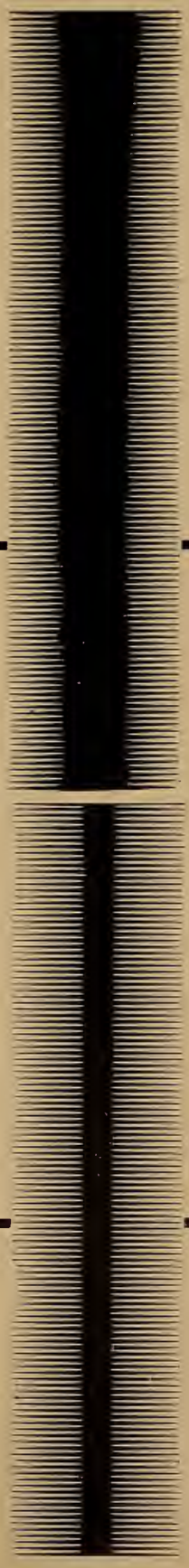
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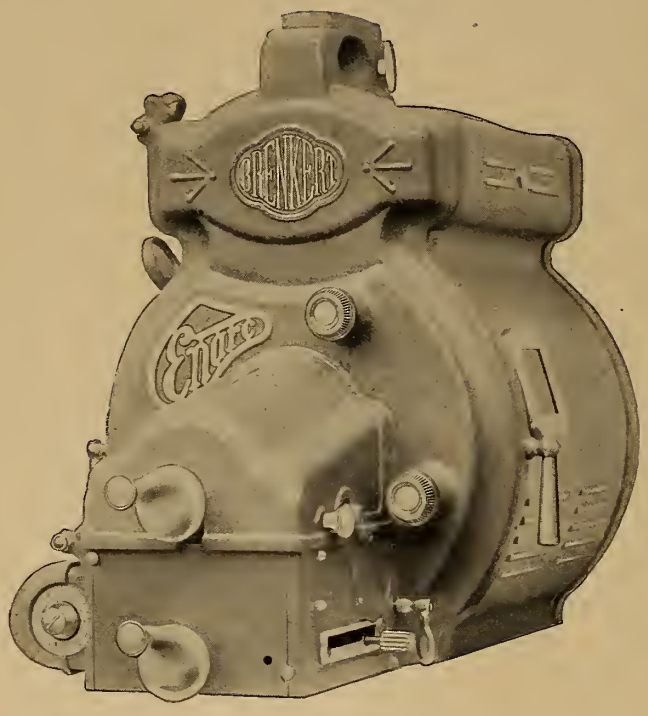
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made by the double-reel sponsors to secure an *official* expression of opinion from the Alliance on the project. Instead, the plan of contacting *individual* Local Unions on a purely *local* basis was adopted (oddly reminiscent of the mess made of the standard aperture several years ago) pressure being exerted in localities where the projectionist units were known to be definitely antagonistic toward the longer reel.

This was the situation which provoked the bitter scorn of I. P. on the score of craft disorganization on technical matters, when producer-distributor agents entered one city and mopped up all around through obtaining the approval of the I. A. unit, the while another I. A. unit only a few miles away was exerting every effort in opposition to the proposed standard. The organized craft obviously was not blameless in this situation, and it richly merited the bricks thrown in its direction therefor. However, this fact in no wise excuses the negligence of the double-reel proponents in failing to go direct to the top for Alliance approval.

While all this localized palavering was going on, difficulties started to pile up in the path of the double-reel: continuing distributor opposition, the necessity for changing local ordinances, and complaints from theatres in which were old Powers projectors with magazines that would not accommodate the longer reel. With trouble piling upon trouble, the sponsors of the double-reel began to feel the least bit dubious about its ultimate success, thus inviting consideration of a possible "out" in the event of failure.

Then occurred the crowning blast: localized projectionist opposition suddenly assumed national proportions when the I. A., through its *Official Bulletin,* expressed emphatic disapproval of the double-reel and instructed all affiliated units to exert every effort to prevent its adoption and use. This blast rocked the house so carefully constructed by the reel's sponsors; but it also provided the much-needed "out" and made the Alliance the scapegoat in the entire proceeding—the exact situation which I. P. foresaw and sought futility, it appears, to keep from developing.

And so it is that today "the Unions" stand convicted of having slaughtered the double-reel—despite the fact that the reel's sponsors are equally guilty, if not more so, in having worked over the proposition on a purely local basis rather than through a centralized authority. With incredible ineptness the handlers of the double-reel project invited precisely the results obtained.

I. P. repeats its original suggestion. Let the sponsors of the double-reel go direct to President George E. Browne of the I. A. and lay the proposition on the line in some such fashion as this:

"Mr. Browne, we are interested in having adopted on nationally a standard release reel of not more than 2000 and not less than 1750 feet. We feel that this standard represents a substantial advance in the art through decreased costs and improved projection. We should like to have an opinion from you as to the attitude of your organization on this proposed standard."

Craft Attitude Important

This much having been done, President Browne could answer either "Yes" or "No," as he preferred; but in either event the double-reel adherents would know exactly where they stood with respect to the organized craft. Eliminated at one full swoop would be the necessity for main-line and side-line junkets into this, that and the other city or town, with the accompanying necessity for pulling, tugging and hauling on Local Union officials, petty politicians and fire authorities.

It doesn't necessarily follow that upon President Browne's answer would depend entirely the introduction of the new reel standard, which might be put through irrespective of the attitude of the Alliance. But it does follow as a matter of reason that the *success* of the reel *as a standard* is largely dependent upon the reception accorded it by the thousands of projectionists who daily handle thousands of reels of films in theatres and elsewhere and their attitude will naturally reflect that of their parent body, the Alliance.

Apart from all these considerations, however, let there be an end to this aimless stewing around that has marked this project to date, and let there be at least a show of direct, positive action. The very worst the double-reel sponsors can do is to get a "No" from President Browne, but even this situation will be not worse, but actually a great deal better, than the spot in which they now find themselves.

If the Unions are to be charged with killing the double reel, let's make it official.—J. J. F.

Electrics Make Drastic Rate Slash to Combat Union Service; Defense Cited

INDICATIVE of the terrific pressure being exerted by projectionist organization servicing activities is news from San Francisco that Local 162 has just lost a circuit of theatres heretofore on Union's service list, as a result of the sound company making a deal whereby the theatres are given full service at an extremely low price, plus all necessary parts *absolutely free of charge!*

Many projectionist organizations, including San Francisco, consider this as a new tack by the electrics, in an effort to block Union servicing; but I. P. sees it only as a modification of the existing flat-rate-per-week Repair & Replacement contract used by Erpi, which included full service. Obviously, under this plan the electrics operated at a loss during some weeks of the year, either for actual service work or for parts supplied. Overall, however, the 52-week average on both items worked out to the electrics' advantage—however much hooey is inherent in such a plan. The R. & R. plan is attractive to theatre owners not because of any inherent advantages but only by contrast with the old exorbitant service charges. A man caught by his arms and legs in a trap would be glad to have at least his arms freed.

In reporting this incident to I. P., San Francisco supplied the answer as to how to combat such activity by the electrics. First, the theatre was enabled to gain such a deal, and the sound company was forced to offer it, only because of the existence of Union servicing! In other words, the Union itself drove the price of servicing and parts down to a level where the electric was *forced* in desperation to slaughter rates.

Second, and finally, it is highly questionable whether the theatre circuit involved will effect any saving through the deal, because the electric's servicemen still can not work except in the presence of a L. U. 162 man, *probably at overtime rates!* Here again is concrete evidence of how a Local's rigid adherence to Alliance rules operates to protect it at every turn.

Of course, what the theatre circuit overlooked entirely was the fact that the slash in the electric's terms was effected only because of the existence of a Union servicing department, thus providing the strongest possible argument in favor of a continuance and expansion of such service throughout the country. Slashed service charges are the surest indication that the Alliance is moving in the right direction on servicing and that the electrics are panicky. There remains now the job of chasing them completely from the sound system servicing field.

I. P. has received a communication from Mr. J. K. Elderkin, of Forest Manufacturing Corp., in which is set forth some pointed critical comment of an article[1] by Mr. C. C. Dash, of Hertner Electric Co., contributed originally to the S.M.P.E., which discusses various units of power supply for projection arcs. In line with its well-established policy of providing a forum for the expression of opinion by those who have something interesting to say on technical matters, I. P. presents here Mr. Dash's paper and Mr. Elderkin's comments thereon.

Needless to say, further comment by either of the aforementioned gentlemen, or anybody else, on the matter under discussion is invited.—*Editor.*

Sources of D. C. Supply for the Suprex H. I. Arc

Two Comments on Relative Efficiencies of Various Power Supply Units

By C. C. DASH

HERTNER ELECTRIC COMPANY

THE introduction of the non-rotating, high-intensity reflecting arc has presented a problem to the electrical manufacturers in the production of a satisfactory source of d. c. for use with this arc, the operating characteristics of which are quite different from those of the previous types used in motion picture projection. The new arc is much more susceptible to changes of voltage in the d. c. source than the old arc, hence must be handled more carefully, and more precautions must be taken in selecting current supply equipment.

(*A*) D. c. power service from central station.
(*B*) A. c. to d. c. converting equipment.
(1) Non-rotating equipment:
  (*a*) Hot cathode tube rectifiers.
  (*b*) Copper-oxide rectifiers.
(2) Rotating equipment:
  (*a*) Synchronous converters.
  (*b*) Motor -generator sets.
    (1) Generator for each lamp, drooping characteristic, no ballast.
    (2) Generator, flat-compounded using ballast.

A.—D. C. LINE SERVICE

When d. c. service is obtained from a central station, the auxiliary equipment used with the arc need be only properly designed ballast rheostats having a sufficient voltage-drop to limit the current to the proper value at the correct arc voltage. In the average theatre installation the voltage delivered by the central station usually increases at about nine o'clock p. m. and it is necessary to have some easily operated regulating device upon the ballast rheostat so that the resistance can be changed in order to compensate for this increase in supply voltage. When considering the overall efficiency of using d. c. from a central station, it must be borne in mind that the current cost per kilowatt hour from such a source is usually much lighter than that paid per unit when the power is obtained from a. c. mains.

For an arc voltage of 35 volts and a current of 50 amperes, the total power drawn from the d. c. line at 115 volts is 5750 watts, of which 1750 would be utilized in the lamp and 4000 consumed in the ballast resistance in the form of heat. The overall efficiency, therefore, is 30.4 per cent. The inrush of current when the arc is struck, using the form of supply, is but very little greater than the normal operating value, and does not exceed 10 to 15 per cent more than the normal operating current.

The power equipment in the central station or in a central system usually consists of a multiplicity of types and sizes of generators. In some instances storage batteries are floated across the d. c. line, so that there is practically no ripple and the current is practically true d. c. The noise in an arc is a function of the ripple in the d. c. supply, and inasmuch as there is no ripple with such an arrangement, there is practically no hum in the arc.

The current through the arc is very steady, due to the large ballast drop, but the results attained with a meter for measuring the steadiness of the light indicate considerable variation of the luminous intensity upon the screen due to the fact that the arc voltage can vary considerably without a compensating change in the current, and thereby affect the light output. The operating characteristic when working on the d. c. power

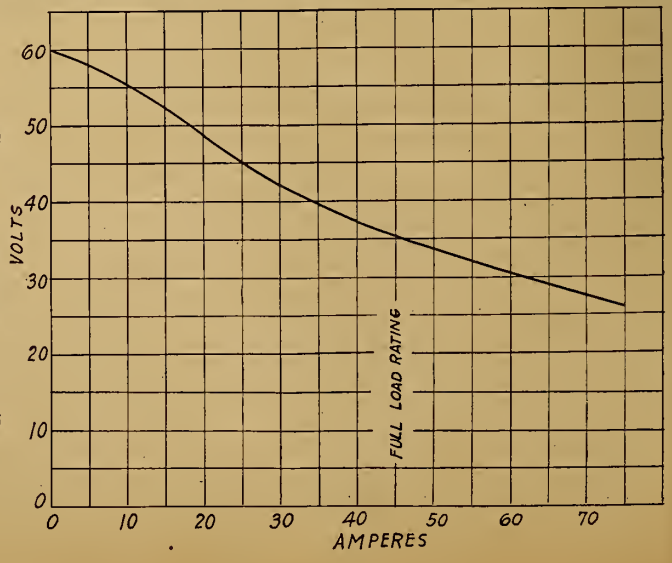


FIGURE 1

Volt-ampere characteristic of the hot cathode tube rectifier

[1] "An Investigation of Sources of D. C. for the Non-Rotating, High-Intensity Reflecting Arc," S.M.P.E. Journal, XXVI (Jan., 1936) No. 1, p. 79.

line is not important to the projectionist as long as the power source remains steady and the voltage does not fluctuate suddenly.

B.—A.C. TO D.C. CONVERTING EQUIPMENT

Non-Rotating Equipment

(*a*) *Hot Cathode Tube Rectifier.*—These use no ballast resistance between the tube and the lamp, are made to operate from three- or two-phase supplies, and may be operated on single phase. The overall efficiency of one that was tested, using an arc voltage of 35 and an arc current of 50 amperes, was 65.5 per cent. The power-factor when supplying the aforementioned load was 65.6 per cent. The inrush of current when the arc was struck varied between 75 and 95 amperes, or an average of 85 amperes for the 50-ampere arc. These readings were taken with an aperiodic meter. The volt-ampere performance of this type of rectifier is shown in Fig. 1.

The ripple in the d. c. produced by the rectifier has a frequency of 240 cycles, the transformers being connected in the open delta arrangement. The rms. voltage of the ripple when the rectifier delivers 50 amperes at 35 volts is 4.25. When operating without load, the rms. voltage of the ripple is 14.5. The result is that the ripple produces noise in the arc of such frequency that it may cause interference.

Voltage Fluctuation Effect

The current in the arc varies between 46 and 60 amperes when the rectifier is adjusted to supply 50 amperes at 35 volts. Part of this change is due to the characteristic of the arc, but most of it is due to fluctuations in the a. c. line voltage. In the hot cathode tube rectifier, the d. c. output is magnetically connected to the a. c. input so that fluctuations in the a. c. line voltage are carried directly through the rectifier, causing magnified fluctuations in the screen illumination. In the case of gradual changes of the a. c. voltage, correction can be made by changing the taps on the rectifier transformer; but when the changes occur suddenly they can not be compensated for; and when the voltage increases, the tubes and the carbons become overloaded, resulting in decreased tube life as well as increased carbon consumption and a flare upon the screen.

The question of tube life is very uncertain. The average estimated life is 1000 hours, so that figures applying to the operating cost of the hot cathode rectifier should include the tube cost in order that they may be on a comparable basis with the costs of other types of equipment. If the arc is not properly handled, a surge may occur and damage the tube.

(*b*) *Copper-Oxide Rectifier.*—The copper-oxide rectifier recently placed upon the market also operates without any ballast resistance between the rectifier and the arc. The overall efficiency of a copper-oxide rectifier that was tested, supplying a 50-ampere arc at 35 volts, was 65.5 per cent, including the fan and relay losses. The power-factor when supplying a normal load was 93.6 per cent; and the inrush of current when the arc was struck, using the same equipment as was used in former tests of this nature, averaged 95 amperes.

Figure 2 shows the volt-ampere characteristic of the copper-oxide rectifier. The rms. ripple voltage is 1.2 volts, the frequency in this case being 360 cycles. The ripple causes considerable noise in the arc, but it is difficult to give any comparative values of the noise with the two types of rectifiers. Observations showed that this arc was not as noisy as the arc produced by d. c. supplied by the hot cathode rectifier. In operation, the arc current and voltage seemed to be steadier in that the changes were slower than the corresponding fluctuations in the hot cathode rectifier. This type of rectifier can not be operated without a ventilating system because the high temperature that is developed is extremely detrimental to the life of the oxide film. The copper-oxide rectifier transmits a. c. line voltage fluctuations through to the arc just as does the other type of rectifier.

ROTATING EQUIPMENT

(*a*) *The Synchronous Converter.*—

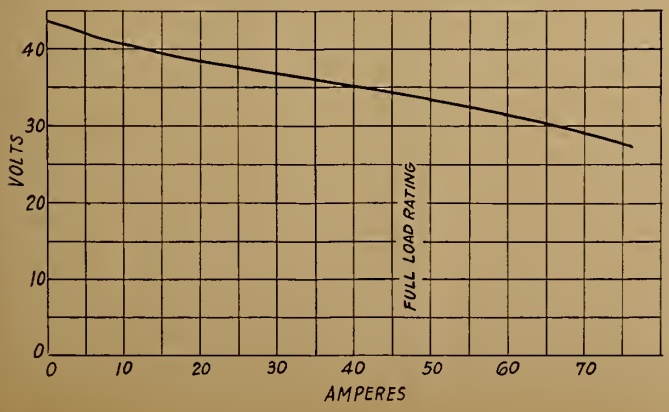


FIGURE 2

Volt-ampere characteristic of the copper-oxide rectifier

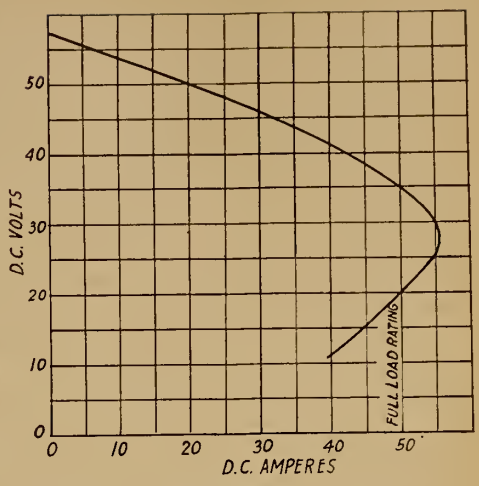


FIGURE 3

Fast-drooping characteristic of early shunt-wound generator

The synchronous converter does not lend itself readily to this application because the low voltage required for the non-rotating, high-intensity reflecting lamp necessitates a d. c. output at 42-45 volts and an a. c. input to the rectifier at 28 volts. This presents a very serious problem in slip-ring and a. c. brush design in order to keep the cost of the machine within commercial limits. It is necessary also to use a static transformer in order to bring the existing line voltage to the 28-volt value required for the converter. We do not know of any synchronous converters being offered for use with this type of arc.

(*b*) *Motor-Generators.*—Motor-generator sets of various types have been used for supplying d. c. to the projection arcs since the advent of the motion picture. In the earlier days, a shunt-wound generator having a fast-drooping volt-ampere characteristic, shown in Fig. 3, was used. This generator was very successful with the old style vertical carbon arc having a voltage of approximately 55 volts. The first of these generators was built to operate one lamp only; and when it was desired to make the change-over, the arc for the second lamp was "stolen" from the first, the two arcs being connected in parallel with no ballast resistance in the arc circuits. The instant the arc was struck on the second projector, the arc on the first projector would be extinguished. Such a condition was not satisfactory from an operating standpoint, with the result that later developments raised the possible operating voltage of the generator so that two arcs could be simultaneously operated in series during the period of change-over.

Old Series Arc Sets

The old series arc sets were very efficient inasmuch as they utilized the entire copper capacity of the generator at rated load. The magnetic circuit, however, had to be of such proportions as

to carry sufficient magnetic flux to produce the required open-circuit voltage; consequently, the material costs of these machines were a little higher than those of constant-voltage machines for the same operating voltage and normal full-load current. The overall efficiency from line to generator was high, due to the absence of ballast resistance in the projection arc circuit.

When used with the non-rotating, high-intensity lamp, this type of generator must be designed for a lower operating voltage than was desirable when it was used with the old style open arc. It also has to be designed so that within the operating range of voltage, the current will tend to increase slightly with decreased arc voltage. This is necessary in order to assure any stability of the d. c. arc, and is one of the characteristics of the horizontal arcs wherein they differ from the vertical arcs formerly used.

It has been found with the shunt-wound type of generator using no ballast resistance between the generator and the arc, that unless a reverse series field is used to produce the constant-current effect, making it differentially compound, it is difficult to attain perfect commutation and long life of the commutator.

In order to maintain the current approximately constant with this type of machine without a reverse series field, it is necessary to shift the brushes in the direction of rotation so that the armature reactions are demagnetizing. If not carried too far, this would provide a better commutating position than the no-load neutral point on a non-interpole machine; but to gain this result, the brush-shift has to be greater than is desirable to attain good commutation, and the coils undergoing commutation would then be outside the commutating field. Poor commutation results also from insufficient saturation of the magnetic circuit, since the latter is saturated at the open-circuit voltage while at the operating voltage the main pole flux is weak.

In one type of motor-generator that was quite popular several years ago, the commutation was materially improved and made satisfactory by an adjustable interpole, the position of which could be shifted so that its field was directly over the coil undergoing commutation when the brushes were shifted to attain a practically constant current.

Hidden Poor Commutation

Unsatisfactory commutation is not always evident when the generator is first put into operation. A burning apparently occurs beneath the brush, which does not cause visible sparking and does not manifest itself until the machine has been in service for some time, when the commutator begins to blacken and trouble begins.

When the non-rotating, high-intensity reflecting arc was first proposed it was found possible to operate it directly across the terminals of a constant-voltage generator and obtain a steady arc. It was found, however, that additional stability of the arc could be gained by using a small ballast resistance in the arc circuit with a constant-voltage, d. c. source. While the arc operating directly across the generator was perfectly stable under laboratory conditions, it was soon discovered that under operating conditions, and because of the wide variation in ideas as to what constituted proper arc voltage, the operation was not so successful.

The overall efficiency of the series type of dual generator unit (using two generators driven by a single motor) built for use with the non-rotating, high-intensity arc, averages 60 per cent when delivering 50 amperes at 35 volts. This presupposes that the field circuit of the generator that is not supplying current to the arc is open, and is thus not consuming power needlessly. The power-factor averages 82 per cent on normal load. The inrush of current to the arc when struck is 77 amperes.

The commutator ripple is a very complex wave, but is practically negligible, resulting in an extremely quiet arc. As the two generators are driven by a single motor, the first arc will show a diminution in light when the second arc is struck, due to the increased slip of the motor. When operating one arc continuously, the current varies from 48 to 53 amperes, the arc voltage varying from 35 to 38 volts when maintaining a constant arc length.

Where shunt-wound generators having drooping characteristics are used to supply current in the modern theatre it is customary to use one generator for each lamp. In some cases the two generators are driven by a single motor. The connections to the lamp switches are made in such a manner in some cases that the field circuit of the generator is not energized while the arc is off; when the lamp switch is closed, the field is energized just before the arc is struck. The output voltage decreases as the temperature of the field windings increases, the decrease being most rapid during the first ten to fifteen minutes of operation.

In order to minimize this effect, in occasional installations the field circuits of the two machines are kept closed even when the machine is not delivering current to the arc. The idle machine delivers a high open-circuit voltage, causing excessive copper loss in the shunt field coils as well as a high iron loss, and the generator runs much hotter than normal. Although operating in this manner lessens the change that occurs in the output current and voltage due to the temperature changes of the field windings, it results in a lowering of the overall efficiency of the set from 60 to 53.7 per cent.

The flat-compounded generator can be designed for the best operating characteristic both as regards voltage regulation and commutation. The magnetic circuit can be designed so that a fair degree of saturation is attained under normal operating loads. The interpole field can be proportioned so as to neutralize the armature reaction and also provide a commutating field of the proper strength for perfect commutation. The brush position can be regulated so that it is squarely in the commutating field. This type of generator is generally understood by the average electrical maintenance man. Incidentally, it will also carry a heavy overload, should occasion arise; whereas the drooping characteristic unit is limited to practically its rated amount.

Commutator Ripple

After a long series of tests using various generator voltages with corresponding values of series resistance, it was found that a generator having a very flat volt-ampere characteristic at 42 volts, with sufficient ballast resistance to maintain the proper arc voltage of 35 volts, would be very stable in operation (Fig. 4). For the best results from a machine of this type, the design must be such

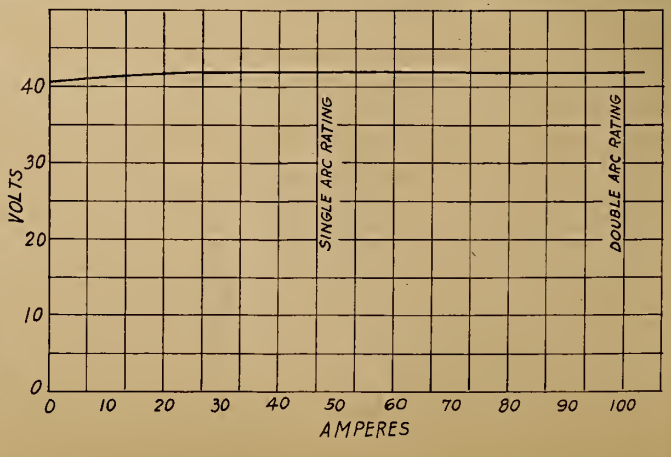


FIGURE 4

Volt-ampere characteristic of flat-compounded generator of double-arc capacity

that the commutator ripple is reduced to a minimum, and that the copper loading in the armature, interpole, and series field coils is very low; in other words, the resistance drops must be practically negligible.

The overall efficiency from power line to lamp of a constant-voltage machine of this type, when delivering 50 amperes at an arc voltage of 35 volts, is 60 per cent, including the rheostat drop. The power-factor in the case of single arc loading with one lamp operating is 83 per cent. The inrush of current to the arc when struck, using the 42-volt generator with a suitable ballast and without auxiliary equipment, is 95 amperes.

In the investigations of commutator ripple, it was found that when an armature was used in which the slots were parallel to the armature shaft, the frequency and magnitude of the ripple were practically independent of the number of commutator bars; that is, an armature with 36 slots, 72 bars, and 72 coils of three turns each gave practically the same amount of commutator ripple as an armature with 36 slots, 108 bars, and 108 coils of two turns each, the frequency of the ripple in both cases being identical.

When, however, the armature slots were skewed one slot pitch on the periphery of the armature, the commutator ripple was reduced very materially and arc noise was almost entirely eliminated. In fact, unless the surrounding conditions are such that there was absolute quiet, the noise of the arc could not be heard; whereas quite an audible sound was produced when the arc was supplied with current by a generator having straight armature slots. The ripple voltage in the skew slot armature was about one-eighth of that of the straight slot armature, other conditions being the same.

A feature of the low-voltage machine is that, although the arc may be susceptible to variations of voltage and current, the variations are such that the resultant of the several factors remains substantially constant, as is evidenced by the practically constant illumination of the screen.

A. c. line voltage fluctuations have no effect upon the output of the motor-generator set unless the voltage drops to such a value that the motor slip is abnormal. This would mean a reduction in a. c. voltage of probably 35 or 40 per cent before any perceptible change would occur. The speed of the rotating parts being maintained practically constant, resulting in a constant output to the projection lamps, there is no magnetic connection between the input and the output of the motor-generator set.

A Rectifier Manufacturer Dissents

By J. K. ELDERKIN
FOREST MANUFACTURING CORP.

MR. C. C. DASH'S paper presented before the Society of Motion Picture Engineers and printed in the *Journal* for January, 1936 (the article immediately preceding—Ed.) strikes me as having been prepared with but one purpose in mind, and that to attempt to show by figures and graphs that there is but one correct source of d.c. power for the Suprex arc—a Hertner motor generator.

The circulation of this paper among engineer members of the Society is a matter that disturbs me very little; but I am greatly disturbed at the possibility that Mr. Dash's paper may be circulated widely in the theatre field, and particularly among projectionists, without some supplementary statement emanating from those who may find themselves in disagreement with the premises and conclusions set forth therein.

I. P. appealed to me immediately as the proper medium for an expression of opinion in this matter, and I readily approved of the suggestion made by the editor of I. P. that it would perhaps be well if my comments were not to appear in these columns alone but were to be accompanied by Mr. Dash's paper. This course being the well-defined policy of I. P. that it should present both sides of any controversial topic, I haven't the slightest objection to—but rather welcome—a joint presentation in a given issue.

My disagreement with Mr. Dash's paper springs not so much from any special desire on my part to protect the interests of the rectifier people, because I consider his paper to be unfair to the manufacturers of both rectifiers and other motor generators.

Outmoded Rectifier Design

Under the heading "(a) Hot Cathode Tube Rectifier," Mr. Dash cites figures and graphs purporting to show the efficiency, power factor and volt-ampere characteristics of a rectifier which he tested. The figures given and the description of the rectifier tested are so far removed from those applicable to a properly designed rectifier that I am convinced that the data were strung around a rectifier of Mr. Dash's own design or of some nondescript type, because he describes a rectifier with open delta-connected transformers and having a ripple frequency of 240 cycles.

Such a rectifier design can mean that only two of the three phases are rectified, the third phase not being used at all. The phase displacement of a three-phase system being 60 degrees, the resultant d.c. through rectifying only two of the three phases would approximate the results obtained by Mr. Dash.

A properly designed three-phase rectifier, however, would utilize all three phases either by first changing it to two-phase by means of Scott-connected transformers or by separately rectifying all three phases. In either case, the results would show a much higher efficiency and power factor than is reported by Mr. Dash.

Relative to the volt-ampere characteristic, this can be made as desired, being merely a function of the design of transformer and circuit. Constant voltage at any amperage can be obtained, if desired.

It might not be amiss at this stage to point out that in the volt-ampere graph of the Hertner generator which is compared with that of the tube rectifier, an unfair advantage of the latter has been taken, because Mr. Dash draws his regulation curve without taking into account the ballast resistance which is used with the generator. Since there is at least an 8-volt drop at load in the ballast, and since the generator voltage is 42, it is perfectly apparent that the Dash regulation curve, with respect to the arc, would drop from 42 volts at no load to 34 volts at load. The graph shown by Mr. Dash may be correct with respect to the regulation of the generator itself, but it most emphatically is not correct with respect to the result at the arc, the one point in which we all are interested.

For best operation of the Suprex arc there must be a certain drooping-voltage characteristic, which is obtained in the rectifier by inductance with practically no wattage losses; while the same result is attained in the Hertner generator through use of a ballast resistance with its high wattage losses.

Another statement by Mr. Dash excites my interest: "The current at the arc varies from 46 to 60 amperes when the rectifier is adjusted to supply 50 amperes at 35 volts. Part of this change is due to the characteristic of the arc, but most of it is due to fluctuations in the a.c. line voltage."

Suprex Arc Fluctuations

This statement appears to me to be substantially incorrect. In the first place, the arc voltage is not "35 volts at 50 amperes" if the arc gap be correct, but is 32 to 33 volts; and if operated at 35 volts with a consequent wide arc gap, the arc is very unstable. Second, Mr. Dash neglects to state that the fluctuation in current with the same arc

(*Continued on page* 28)



Present automotive equipment for L. U. 160 theatre service, pioneer Union servicing department. Contrast these cars with the first mobile unit shown elsewhere in this article

Cleveland Plan Embraces Emergency and Engineering Theatre Service

By VICTOR WELMAN
SECRETARY, LOCAL UNION 160, CLEVELAND, OHIO

So many requests for information relative to theatre servicing have been made directly to Cleveland L. U. 160 that I. P. sought and obtained this summary of the plan which treats with those questions most commonly asked.—Editor.

THEATRE service rendered by Cleveland Local 160 (projectionists) has been the topic of numerous published and oral statements, all of which were undoubtedly well-intentioned but some of which were misstatements of fact. Thus, we might begin aright with a definition of terms and say that our Theatre Service is of two kinds: (1) emergency and (2) engineering—between which there exists a sharp distinction.

Emergency service has been rendered by Local 160 *for fifteen years* and has as its object the insurance of continuous operation of the theatres in our city under any and all conditions. This service is of such nature that we can cope with almost any situation occurring in the projection room, even to the extent of having a theatre back in operation within one hour after a major fire, through the use of temporary power cable, amplifiers and sound wiring.

The Engineering Service provided by the Local has been developed since the introduction of sound pictures, and includes regular inspections of the equipment.

Central Service Office

Local 160 maintains at a central location an office which is open during all theatre hours, having a telephone and two or more attendants, plus two trucks equipped with all the material which we found in fifteen years of experience to be necessary. The telephone number of this Emergency Station is so listed in the regular city directory, and a card showing the number is hung in each theatre office and projection room. In case of trouble, actual or threatened, the theatre manager calls the Emergency Station, whereupon an engineer responds with his truck of supplies and equipment. Such repairs are then made or equipment is installed as may be necessary to keep the show running properly through the evening.

No charge is made for this service work and no rental is assessed for the equipment loaned; but the theatre is required to replace any loaned equipment on the following day, so that it will be available for other theatres the next night.

The focal point of this Emergency Service, if not already made clear, is to keep the equipment operating, the show running and the theatre open so that it may do business. Local 160 assumed this extra responsibility in recognition of its own vital interest in having all theatres continue to operate. No other consideration is permitted to obstruct this single service goal. Needless to say, exhibitors recognize that this Local 160 service is a most valuable form of protection, an insurance policy against an interrupted show.

Now as to the Engineering Service branch. Details of this service might be prefaced by the unqualified statement relative to our view that all work incident to not only the projection of pictures and sound but also the installation and upkeep of equipment used therefor belongs to the members of our International Alliance. This idea has been so firmly implanted in Cleveland that there exists not even a suggestion of doubt relative thereto.

Local 160 insists that every bit of work done on any theatre equipment be performed by its members assigned to a given theatre. Should engineers or any manufacturers' representatives present on a job make constructive suggestions, our members lend acceptance thereto; but all non-members are required to keep their hands off all tools and equipment. This policy has been in opera-

tion successfully in Cleveland since the first installation of sound picture equipment, to the complete satisfaction of both the manufacturers and theatre owners.

Where the theatre so desires, we supply our own engineers, members of this Local, to supervise any repair or installation work which may be done outside of regular theatre hours, for which service there is made a charge for the time employed at the scale set for that work. In many cases contracts have been signed for regular monthly inspections of equipment at a set rate—which interesting statement may serve to deflate the numerous claimants to the honor of having "originated" the idea of contracts covering periodic inspection or repair of sound equipments.

Service Truck Equipment

The equipment of our service trucks generally includes the following:

Mechanisms for Simplex, Powers, Motiograph and Superior projectors, with an assortment of gears and parts, including complete movements for these machines; also various lamp parts that require replacement.

One complete portable A. C. Amplifier, 10-watt output, with pre-amplifiers, exciter lamp supply, and tapped output for various speaker connections.

Power supply for 300 volts and for 2½ volts.

A large potentiometer for connecting across the aforementioned 300 volts or across the power supply of the theatre equipment, in cases where the 90-volt supply goes out but the high voltage is operative.

Also included in the equipment of the service trucks are the following accessories:

10-volt speaker field supply; 110-volt speaker field supply; coupling transformer, 500 ohm to 16 ohm, tapped; exciter lamp supply from 110-volt line, and a condenser box tapped for various capacities (similar to a decade resistance box); assorted resistors, condensers, grileaks and tubes; an output meter, continuity checkers, and S.M.P.E. test reels.

Relative to the type and quantity of test equipment carried, it is well known that rarely do two servicemen agree on this topic, each of whom likely will supply his own equipment. Our men seem to be partial to the Hickock five-meter outfit largely because, in addition to all ordinary individual readings and tests, it is possible with this outfit to obtain all the readings of a tube simulantously and thus get a better picture of its operation. However, now that 6- and 7-prong tubes are coming into sound work, and 8-prong and metal tubes are on the way, a free-point box becomes necessary and the five-meter outfit loses some of its advantages.

The Local also maintains a sound truck equipped with portable projectors and amplifiers for putting on sound picture shows anywhere, a public address set, and equipment taking sound pictures (sound recording and photography).

In looking back over the fifteen years of such service rendered by the Local, it is very interesting to note the evolution of the art of reproducing motion pictures as reflected by the changes in the type of work done, in the equipment carried, and in the nature of the personnel required for the exacting standards of present-day servicing work.

At first the electrical equipment required was of the simplest, it being necessary to carry only a rheostat for emergencies, a few gears and belts, an assortment of condenser lenses, and lamp jaws and lugs. Then motor-driven machines were introduced, and we added a line of a.c. and d.c. motors with special mountings, so that they could be attached to any kind of a stand. Next came motor generators and converters, and a man was added to the service staff who could make any kind of a generator or starting box work under almost any condition, a stock of brushes being added to his supplies.

Sound picture were then introduced, precipitating a complete revolution in servicing requirements and necessitating the training of the entire Local membership in a new art. Cleveland Local 160 was particularly fortunate in this respect in that it had maintained for years a school for apprentices and younger members to which the older members were not too proud to go. Immediately sound pictures came in, this school turned to sound pictures and concentrated thereon, with the entire Local membership being brought in.

Service a Valuable Asset

Local 160 feels well satisfied indeed with the work thus carried on. It has accomplished that most valuable service of extending to theatre managers positive assurance that means are instantly available for keeping their shows going under almost any conditions. Better relations between the Local and the managers is an invaluable outgrowth of our servicing activities, along with giving our members added confidence through knowing that expert advice was available for any sudden problem that might arise, which in turn inspired among our members a sincere desire to study their own problems.

We encourage both managers and projectionists to use the emergency service freely, our viewpoint being that it is far better to make five unnecessary calls, if we must, than to delay making one call which later develops into serious trouble.

The Story Behind the Story of Cleveland L. U. 160 Service

By JAMES J. FINN

THERE is a story behind the accompanying story detailing the operation of Cleveland L. U. 160's theatre servicing plan. Marked by considerable restraint and a complete absence of shoulder-patting, Victor Welman's article is a satisfactory technical exposition, but its most important appeal to the craft lies in what was left unsaid. Development of these important angles will be attempted in this supplementary statement.

Extremely interesting is the fact that L. U. 160 has been rendering theatre service, apart from the usual installation and projection work, for the past fifteen years—thus demolishing the assertion frequently made by the electrics that they introduced a regular, periodic repair and replacement service in this field. Regular equipment service to theatres apparently was never thought of by a projectionist union fifteen years ago—except by L. U. 160, which had an eye peeled to the future.

L. U. 160 service is unique in several other respects. As stated, it consists of two classifications: emergency and engineering. The former division is of particular craft interest in that it represents a voluntary move on the part of the Local to accept the responsibility for keeping the theatre open and the show going—absolutely *free of charge*. Here is an activity that is in the best tradition of show business, the reduction to practice of that much-ballyhooed but seldom adhered to principle that the "show must go on."

The Show Must Go On

Obviously, to L. U. 160 the show must go on not because of any sentimental fondness for a phrase that has worn well but only because L. U. 160 members derive their livelihoods from those theatres which the Union is very anxious to keep open and doing business—a clear-cut case of mutual welfare, as L. U. 160 sees it. So insistent is L. U. 160

that the theatres, its employers' property, enjoy maximum returns that it offers, at no inconsiderable expense to itself, a *free service*. Selfishly inspired this plan may be, yet its practical benefits are indisputable. Tell this story of a Union's interest in its clients' welfare to any Labor die-hard, and he would promptly voice his disbelief and demand proof thereof.

Reduced to its bare essentials, the L. U. 160 plan of free emergency service reflects the organization's idea that its welfare is intimately related to the welfare of its employers. This is progressive Unionism at its best.

But, it may be asked, doesn't this type of service cost L. U. 160 a pretty penny? The answer is: certainly. But the costs and much more all come home in the form of exhibitor reliance upon and good will toward L. U. 160 at contract time. To which there simply isn't anything further to be said.

This emergency service exemplifies to the highest degree every argument advanced in recent months by I. P. to the effect that the good will to be gained by unions through intelligently-conceived and competently-executed general theatre service far outweighs any consideration of cost, inconvenience or any other factor. I. P. has consistently backed the theory that servicing operations provide an incomparable means of making the exhibitor-customer reliant upon a union for something more than merely manpower for so many hours a day, so many days a week for so much money. This tieing-in process is nothing more than good business sense.

Another aspect of the Cleveland servicing situation is that no service man not a member of the Union has ever done any work in the projection room, irrespective of his affiliations with the electrics or otherwise. This has been the rule of all unions since the introduction of sound pictures, of course; but precious few projectionist organizations can honestly say that they rigidly enforced this rule. In fact, the wide latitude enjoyed by the electrics' servicemen from the start in this respect was the direct cause of the electrics' recent attempt to extend their sphere of influence to include the entire theatre plant. This writer has frequently seen servicemen working in projection rooms the while a Union man or men stood idly by.

L. U. 160's engineering service is, of course, self-explanatory and differs not a bit from the service advertised by the electrics as one of their chief benefactions upon the industry. Periodic inspection service at a rate agreed upon in advance is the Cleveland plan, and it is evident that no electric can possibly offer as much—at least in Cleveland. The L. U. 160 service is several jumps ahead of the electrics, in fact, because it covers every unit of equipment in the theatre—not only the sound equipment but everything else having a bearing on the operation of the plant. Here again stress is placed upon the vitally important consideration of insurance that nothing occasions a shutdown.

Important Notice!

Inaugurated with this issue is a new system of serving *final* notice of subscription expiration upon I. P. readers. *First* notice of expiration will continue to be mailed direct to the subscriber a month in advance of expiration date. The second and *final* notice of expiration, however (formerly also mailed direct to the subscriber) will be bound into the last copy received under a given subscription.

Use of this folder is simple: merely tear apart along perforated line in center, write in your name and address in the space provided, check box for term of order (whether for 1 or 2 years), enclose remittance and then seal over the flap of the self-addressed envelope provided.

Remember—whenever your copy of I. P. includes one of these pink notices, your subscription has *already expired*. No further notice or copies will be sent.



L. U. 160's first mobile theatre service unit

As explained by Mr. Welman, the test equipment carried by the L. U. 160 servicing trucks reflects the personal preferences of the men doing the work, rather than a "must" list which might serve as a model for other servicing enterprises. Mr. Welman's statement that L. U. 160 is prepared to effect the reopening of a theatre within an hour after even a major breakdown—such as might be occasioned by fire—is sufficiently indicative of the variety of equipment carried and the thoroughness of L. U. 160's preparation.

Nor are the Local's servicemen "on their own" on any particular job they might encounter. The writer knows of no organization that was so persistent in, or spent so much time and money upon, educational activities as did Local 160. Mr. Welman's statement that the "entire membership was brought in for sound picture sessions" means just that —with no exceptions. Every conceivable aid for the classes, in the form of equipment or literature, was made available. The result is that practically the entire membership is, to say the least, fairly well grounded in the fundamentals of the electronic art—an invaluable asset to the Local in its everyday work and no little help to the serviceman when he reports on a trouble call. All this naturally cost the Local a great deal of money; but today the organization is reaping the benefits of whatever sacrifices were involved in shaping an intelligent course toward the future.

Organization Benefits

Coincidently, passing reference must be made to the fact that wherever there exists a progressive organization, aware of its responsibilities and willing to contribute to the business a little bit more than so many man-hours per week, there also you will find the best organization conditions—not necessarily from the standpoint of income per man (although this certainly is true in Cleveland) but on the basis of complete organization of a city. San Francisco is another large-city witness to the accuracy of this observation.

All of this activity on the part of Local 160 has generated an interest on the part of the individual member in the progress of the Local, his organization, and has tended to make each member more self-reliant by reason of the knowledge that he has gone through the educational mill, is just as good as, if not better than, a fellow on a projection job anywhere else, plus the fact that the service department of his own Local is ever ready to back him up or unravel the knots in any particular difficult problem.

Pride in one's own Local is another

(*Continued on page* 26)

The [I P] EDITORIAL PAGE

Vol. 10, No. 2 FEBRUARY 1936

Free and Open Discussion Aids Progress

Inclusion in this issue of a joint presentation of Suprex arc power supply data (motor generators and rectifiers each having an able protagonist) serves to emphasize anew the long established policy of I. P. to do everything possible to encourage full and free discussion of all vital projection topics. It is extremely difficult to publish an opinionated organ (which we hope I. P. is) without incurring at some stage of the game the displeasure of either readers or advertisers. I. P. has experienced the wrath of both these groups. However, such incidents merely served to stiffen the determination of I. P. to adhere to its established policy, which over a period of almost five years has been productive of splendid results. There will hardly ever be any lack of controversial topics in the projection field, wherein numerous equipments of varying design, construction and operation generate controversial discussions.

Safety Attachments vs. Common Sense

A few weeks ago this writer was invited by the fire authorities of a town not far from New York to witness a demonstration of a "positive" fire-prevention attachment to a projector. The demonstration was quite interesting and very impressive—until a reel of film in the *lower* magazine inadvertently caught fire and until the noxious fumes and odors given off by the carbon tetrachloride (released through exploding-cartridge action in the head) permeated the room. With the conclusion of the demonstration, opinions were sought and were freely given—verbally and openly. Subsequently, the same opinions were committed to print and signed in letters to the fire authorities.

Reserved for some future time is comment on the political tie-up effected in this instance and on the fact that the Union and the theatre owners lined up on one side, very properly we think, and fought the matter through. No sooner had the projection people present expressed an unfavorable opinion of the device (this writer stating that he was opposed on the score of its menace to craft health alone) than the sponsor of the unit rent the air with cries that the projection people were present only to "slaughter" the device, were antagonistic in advance, had made a "deal" with the theatre owners, were trying to protect a two-men shift situation, etc.; and this writer was singled out as a "racketeer" who used his craft influence to bludgeon manufacturers into line.

All of these charges are true, and particularly the latter; but this is not the topic of the moment. I. P. has long been opposed to projector attachments in general on the ground that ample latitude for effecting improvement exists without loading the mechanism down with gadgets. In the particular case cited here, a manufacturer sought to gain approval for a device which has no place in the projection room and certainly not in close proximity to film in rapid motion.

Precisely the same end would be accomplished if projectionists and theatre owners exercised reasonable care with the projector mechanism, and particularly with fire rollers, film gate, gears and sprockets. There is no more justification for even a brief aperture fire in a projector (apart from badly mangled prints) than there is for murder. And in some instances it comes mighty close to being just that. But, it may be said, neither projectionists nor theatre owners pay sufficient attention to keeping a projector mechanism up to par through frequent overhauling and the constant replacement of worn parts. Our answer is that the cure for this situation certainly does not lie in the *compulsory* use of alleged fire-prevention attachments.

The trick in putting over all such attachments is to stage a demonstration and so impress the fire authorities with the "protection" inherent in such devices that a local ordinance is rushed through *compelling* theatres to use them. Success in a few towns in this respect means that other towns are just pushovers for the promoters. Our slant is quite different.

Why not legislation making compulsory the close attention of the theatre management to worn projector parts? Such legislation surely would be more beneficial to the theatre and to the fire authorities than tons of "positive fire-prevention devices." I. P.'s slant is that it is far better to properly take care of that which we have—the existing mechanism—than to load the projector down and clutter up the room with "safety" appliances. This much having been done, there will be mighty little chance of equipment failure.

There never has been devised any substitute for projectionist alertness *plus* frequent overhauling and the replacement of worn parts as a proven bulwark against the menace of projection room fires. Other compelling reasons, including the projectionist's personal safety, dictate adherence by the craft to this common-sense principle.

I. P. has never heard of any severe projection room fire which ultimately could not be traced down to equipment failure rather than charged against the human element.

Practical Projection and the S.M.P.E.

Reappointment of Harry Rubin as chairman of the Projection Practice Committee of the S. M. P. E. will serve to soothe the ruffled feelings of those members of the craft who felt that their interests were not being accorded due recognition by the Society. The absurdity of establishing a committee to handle practical projection matters and then failing to place the direction of such a committee in the hands of men having records of long practical projection experience is so obvious as to require no extended comment herein. Projectionist participation in Society affairs, unlike that of some other members, occasions a personal sacrifice in time, effort and money; and their interest should be encouraged in every way possible by the Society.

A glance over the record will show that the most fruitful years of the Projection Practice Committee, for both the art and the Society, were those in which the committee was guided, and to a large extent manned, by practical projectionists. This being so, there never existed any good reason for effecting a change in direction, and it is to be hoped that this one experiment will serve to avert another.

Lamp Makers' Stake in Projection

Always crying pitifully for more business (which they accept daily at prices that are a disgrace to decent manufacturing standards), arc lamp manufacturers do nothing to promote their own interests. After two years of constant prodding to contribute data on the Suprex arc (which couldn't help but increase sales) *one* manufacturer contributed *an* article to I. P.—and even this singelton was not what was requested. Daily the offices of I. P. are deluged with releases, some extremely interesting and useful, from companies having only small stakes in the projection field. But the lamp manufacturers, with everything to gain and nothing to lose, evidently are too busy cutting the other fellow's prices to bother with promotional work that might popularize the product to a point where sales could be made at a profit!

Amplifier Characteristics and Methods of Coupling

By M. J. YAHR

SERVICE DIVISION, RCA MANUFACTURING CO., INC.

AMPLIFIERS may be classified as to their properties and characteristics. When divided as to the frequencies to be amplified, they are known either as *radio* frequency or *audio* frequency amplifiers. Audio frequency amplifiers are intended for amplifying frequencies from about 20 cycles per second to approximately 10,000 cycles per second. Generally speaking, frequencies above this value are considered as radio frequencies.

When classified as to the results which the amplifier is to produce, amplifiers are known as either *voltage* or *power* amplifiers. A voltage amplifier is so designed as to produce the maximum possible voltage from a given signal in the input circuit, such as a microphone in the case of public address equipment or a phototube in the case of motion picture sound reproducing equipment. The power amplifier on the other hand is used to produce large quantities of output power which will in turn develop the energy necessary to operate the loud speakers. This paper will be confined to the analysis of voltage and power amplifiers used to amplify *audio* frequencies only.

Ordinarily, it is not possible to secure enough amplification from a single tube, consequently some means must be provided for connecting or coupling succeeding vacuum tubes if sufficient amplification is to be obtained. Three methods of coupling identified as "resistance coupling," "impedance coupling" and "transformer coupling" are the most common methods used. Besides these, some of the methods are used in combination, so that a large variety of circuits are actually possible.

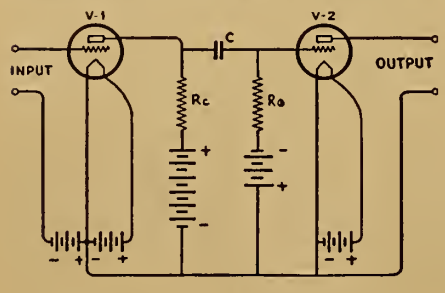


FIGURE 1

Resistance-coupled amplifier

In Fig. 1 is shown a schematic diagram of one stage of a typical "resistance-coupled" amplifier circuit. It consists of a resistor "Rc" in the plate circuit of the first tube and a resistor "Rg" in the grid circuit of the second tube. These are connected or "coupled" by a capacitor "C." Let us follow an audio signal, which in reality is an alternating voltage, through such a circuit to see what happens.

When this alternating voltage is impressed on the grid of the first vacuum tube, "V_1," by connecting it across the terminals marked "Input," a pulsating direct current will flow in the plate circuit of the tube due to the controlling action of the grid. This pulsating current can be considered as consisting of two distinct parts: the first a steady direct current and the other an alternating current.

When the pulsating d.c. flows in the resistor "Rc," which is in the plate circuit of the tube "V_1," a pulsating direct voltage is produced across the resistor. The alternating part of this voltage causes a.c. to flow through the capacitor "C" connecting the plate of "V_1" with the grid of "V_2," and through the resistor "Rg" to complete the circuit.

When this current flows through the resistor "Rg," it causes an alternating voltage to be impressed on the grid of "V_2." This alternating voltage is identical with that introduced originally at the input terminals except that through the amplifying properties of the vacuum tube it is greatly amplified.

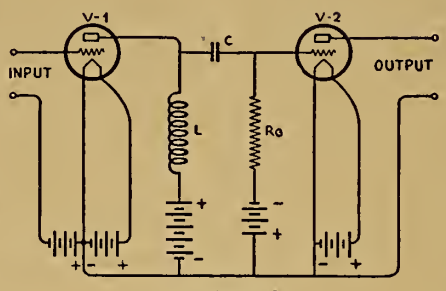


FIGURE 2

Impedance-coupled amplifier

The distinguishing feature of resistance-coupled amplifiers and one which makes it very desirable for some applications of motion picture sound reproducing equipment is its ability to amplify all the frequencies ordinarily considered as audio frequencies substantially the same amount. The amount of amplification available, however, is limited by the amplying ability of the tubes used.

The second type of coupling, known as "impedance coupling," is shown in Fig. 2. Comparison will show that it is very similar to the resistance-coupled amplifier except that a reactor or inductance is substituted for the resistance in the plate circuit of the first tube. This reactor is shown as "L" in the diagram. Essentially, the signal voltage can be traced through this amplifier in exactly the same manner as that used in the case of the resistance-coupled amplifier. The advantages of an impedance—over a resistance-coupled amplifier are, first a somewhat higher amplification per stage is possible; and second, since the reactor can be made to have an insignificant d.c. voltage-drop, it permits the use of a lower plate voltage.

These advantages are somewhat offset by the fact that an impedance-coupled amplifier fails to amplify all frequencies equally, as in the case of a resistance-coupled amplifier. The so-called higher and lower audio frequencies especially are affected. Because of this fact impedance coupling is not widely used, since resistance coupling is used where uniform amplification of all audio frequencies is desired, and transformer coupling is more satisfactory where some loss of high and low frequencies can be tolerated.

The third common method of coupling is "transformer coupling," the schematic diagram of which is shown in Fig. 3. In this type of circuit, the primary of the transformer is connected in the plate circuit of the first tube V, while the secondary winding replaces the resistor in the grid circuit of the succeeding tube V_2.

As explained in the case of the re-

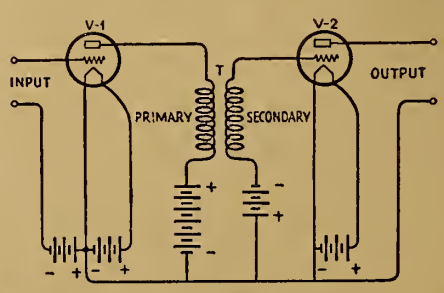


FIGURE 3

Transformer-coupled amplifier

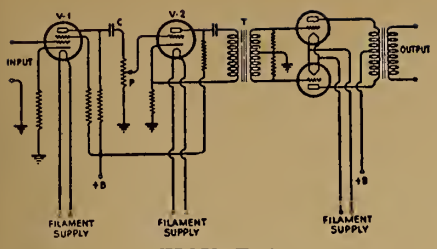


FIGURE 4

Typical commercial voltage amplifier

sistance-coupled amplifier, the pulsating d.c. in the plate circuit of the first tube consists of a steady d.c. together with an a.c. component. The a.c. in the primary, through the well-known transformer action, induces an alternating voltage in the secondary which is then impressed on the grid of the second vacuum tube. If the secondary winding contains more turns than the primary, there is a corresponding "step-up" of this voltage, which means that the total amplification consists of the product of the vacuum tube amplification and the transformer set-up ratio. In this way the total available amplification is not limited by the amplifying ability of the vacuum tubes.

Transformer—Coupled Units

Transformer-coupled amplifiers are the most widely used type of audio-frequency voltage amplifiers. In addition to the high amplification possible, they possess the further advantage of requiring no coupling capacitor or gird resistor while giving substantially constant amplification over the entire range of audio frequencies. Only where the frequency response demands are extremely rigid does the transformer-coupled amplifier give way to the resistance-coupled amplifier.

In commercial practice, a single amplifier may consist of several stages and include both resistance and transformer coupling between these stages. Figure 4 is a schematic diagram of a typical commercial voltage amplifier used in motion picture sound reproduction equipment. Note that the coupling between the first two stages is resistance coupling, while that between the second and third is transformer coupling. This particular amplifier is AC operated, and the filaments of the tubes are consequently heated by a.c. A volume control potentiometer, "P," is inserted in the grid current of the second tube and takes the place of the resistor shown in the previous diagrams of the resistance- and impedance-coupled amplifiers.

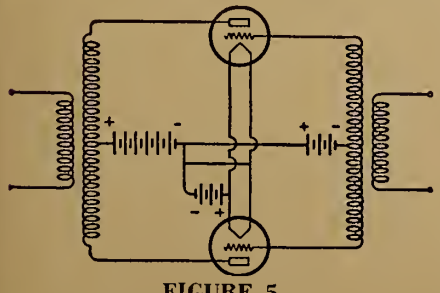


FIGURE 5

Push-pull power amplifier

As stated previously, the audio frequency *power* amplifier is used to produce the output power which develops the energy to operate the loud speakers or similar equipment. The tubes used in such an amplifier are usually called power tubes. When it is desired to secure a greater amount of power than is possible with a single tube, use is often made of two tubes in parallel or preferably in a "push-pull" circuit, such as shown in Fig. 5.

The push-pull amplifier is generally employed in commercial practice because it inherently eliminates certain forms of distortion which it would not be possible or extremely expensive to do otherwise. It should be noted that the last stage of the typical commercial amplifier shown in Fig. 4 is "push-pull" connected.

In order to operate as an amplifier, vacuum tubes must be supplied with voltages from some external source. In the diagrams of typical amplifiers, this external power was shown as being derived from batteries. While it is possible to use such a source of power, known respectively as "A" (Filament), "B" (Plate) and "C" (Grid Bias) batteries, their relatively limited life, maintenance requirements (storage batteries) and bulkiness are disadvantages which have caused amplifier manufacturers to seek other sources of power. In some special instances, motor generators are used to supply d.c. power. As the result of a long period of development, the vacuum-tube rectifier has proven itself almost ideally suited to and has become practically standard in the supply of power for vacuum-tube amplifiers.

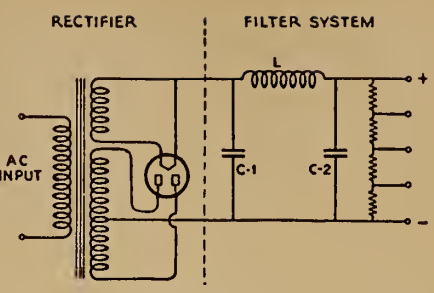


FIGURE 6

Rectifier circuit

It is used almost exclusively in modern high quality sound reproducing equipment.

In a typical rectifier circuit shown in Fig. 6, a vacuum tube will convert ordinary a.c. to d.c., which can be used to supply the direct voltage to the plate of the amplifier tubes. In this particular circuit both halves of the a.c. wave appear in the rectified voltage and the circuit is called "full-wave." Where only one-half of the a.c. wave is rectified, the rectifier is termed a "half-wave" rectifier.

The d.c. obtained from the rectifier is pulsating at a rate equal to the changes in the a.c. from which it was secured, and as such is not satisfactory until it has been "filtered," which means merely the removal of these pulsations. This process is accomplished by means of the capacitors C_1 and C_2 and the reactor L shown in the diagram. The capacitors act as electrical reservoirs, absorbing current when the voltage due to the pulsation is high, and supplying current to the load when the voltage is low. Because a reactor tends to prevent any rapid change of current through it, it further smooths out the flow of current.

The voltage divider resistor shown in the diagram permits voltages of different values to be tapped off for different purposes when necessary.

• LETTERS TO THE EDITOR •

Current and Electron Flow in C. O. Rectifiers

Certain statements in the article on copper-oxide rectifiers by J. K. Elderkin in your December, 1935, issue (p. 18) served to confuse several of us. It is stated first that: "the current passes freely from oxide-to-copper, but with difficulty in the reverse direction"; while thereafter (p. 20) appears the statement that: "A combination of copper and copper-oxide is formed in which it is easy for electrons to escape from the copper to the oxide, but quite difficult for them to leave the oxide and pass into the copper."

The foregoing seems to us to include directly contradictory statements, which we think were set down in error. Possibly we just couldn't get the point of the article; but in any case, would you please advise on this.

J. T. MAWSON
Vancouver, B. C., Canada.

In answer to which is the appended statement by Mr. J. K. Elderkin, author of the article in question:

"Both statements quoted by Mr. Mawson are correct and in no way contradictory. In the first instance quoted I was speaking of *current* flow, and in the second passage quoted of *electron* flow. The current in an electronic device flows in a direction *opposite* to that of the electron flow.

"For example: in a tube, the filament or cathode is emitting electrons, but the flow of current through the tube is from

plate to filament. The cooper-oxide rectifier action is analagous, the copper emitting the electrons, and the current flow being from the copper-oxide to the copper. Making a direct comparison with a tube, the copper is the filament, and the copper-oxide is the plate.

"Questions such as this indicate a keen interest by the craft in technical matters and augurs well for the progress of both the craft and manufacturers in this field."

J. K. Elderkin
Forest Manufacturing Corp.

Independent vs. 'Big Electric' Theatre Reproducers

I had the pleasure of hearing you speak at the last convention of the Independent Theatre Supply Dealers, and was very favorably impressed with your evident desire to see that real independent manufacturers and dealers have an equal chance to do business in the projection field. However, it seems that a majority of projectionists run counter to your ideas, in that they persistently refuse to give the independents a chance and constantly favor the product and policies of the big electrics.

Now, this is certainly not in harmony with the stand taken to date by the Unions against the electrics on the question of servicing. Any Union projectionist should welcome an independent sound reproducing system that offers competition to the electrics.

My own city was one of the first to offer the theatres better service than the electrics ever could give; yet the rank and file of the membership seems wedded to the idea that only the electrics can offer a good sound job. This is sheer nonsense, as has been repeatedly demonstrated.

We independent supply dealers need the co-operation of projectionists everywhere, and it is apparent that we are not getting it. There seems to be a job for you to do here in enlisting the aid of Union officials to see that projectionists are unsold on the notion that only an RCA or Erpi equipment is acceptable, and that the best interests of the craft would be served by closer co-operation with the independent dealers and manufacturers.

A Theatre Supply Dealer

It is obviously not the function of I. P. to attempt to have its readers favor any particular make of equipment, either directly or through Union officials. The latter, in turn, have no control over the make of equipment bought by theatres, nor is it their proper concern. I. P.'s disagreement with the electrics did not spring from pure spite or from a malicious desire to injure the standing of their equipments or to parade I. P. "influence" with the craft. Simply because I. P. is opposed to policies of the electrics (on servicing and the like) which are considered harmful to the craft, is no valid reason for adjudging their equipments to be inferior. Sound reproduction in theatres is too important for either I. P. or the craft to withhold approval of engineering progress or sensible merchandising policies, whether credited to the electrics or the independents.

Of course, I. P. considers it an unhealthy situation wherein any one or two companies monopolize the theatre sound field; although after the equipments are in and the contracts signed, there is little that can be done about it. However, an impartial survey would show that many independents have enjoyed good business in the theatre field, particularly when the electrics, through early development work and patent holdings and large research facilities, enjoyed a big running headstart.

I. P. certainly favors independent participation in all lines of theatre equipment, but this does not warrant issuing blanket disapproval of the electrics' products, however beneficial it might be to the craft and to the industry to assist the progress of independents.—Ed.

News of the Month

NUMEROUS prominent personalities in projection ranks will sponsor a testimonial banquet in honor of P. A. McGuire, for many years advertising director for International Projector Corp., at a New York hotel sometime in April. Date of affair will be announced later.

Testifying to the esteem in which Mr. McGuire is held by projectionists throughout the country, to whom he has rendered invaluable service over a long period of time, is the personnel of the committee which will direct the affair, as follows: Lester Isaac and M. D. O'Brien, Loew's Theatres; Harry Rubin, Paramount; Frank Cahill, Warners; Thad Barrows, pres. of Boston L. U. 182; Victor Welman, L. U. 160, Cleveland; Frank Sutton, Norfolk, Va.; Arthur Martens, L. U. 650, Westchester, N. Y.; R. H. McCullough, Fox West Coast; Willie Ricks, L. U. 224, Washington, D. C.; F. H. Richardson, James J. Finn, and J. R. Cameron; Charles Horstman, RKO; "Chick" Lewis, Showmens Round Table; Lawrence Katz, L. U. 488, Harrisburg, Pa.; Nat Golden, U. S. Dept. of Commerce, and Joe Engel, L. U. 640, Long Island, N. Y.

Details and arrangements will be announced as soon as ready.

'Jake' Mitchell Returns As Motiograph Field Agent

"Jake" Mitchell is returning to active participation in the motion picture industry as traveling representative for Motiograph, Inc., makers of Motiograph De Luxe sound projector equipment. Having been with the industry almost since its inception, Mitchell has acquired many friends therein who will welcome news of his return. He will represent Motiograph in the field, contacting dealers.

Company Union Ruling By N. Y. Supreme Court

Allied Union, bitter opponent of L. U. 306 in N. Y. City, has again been cited as a company union in a court decision of great importance to Labor everywhere. Allied has a ten-year contract with the I. T. O. A. of N. Y. (exhibitors organization) for exclusive use of its members. Three Brooklyn theatres, using L. U. 306 members, recently joined the I. T. O. A. and, according to Allied's viewpoint, automatically became subject to the aforementioned contract. Suit was instituted to force the 306 men out.

"Allied at all times was and still is a company union," said the N. Y. Supreme Court in denying Allied application for injunction. "Allied was organized by the I. T. O. A. and was sponsored by them. Allied never selected a committee to negotiate with the exhibitors for the master (ten-year) contract. Prior to said contract there never was a ten-year contract in the industry, the usual terms of labor contracts prior thereto being for two-year periods. The Allied-I. T. O. A. contract is against public policy."

Costs of the action were assessed against Allied.

Tom Maloy Estate Claim

A claim for $99,255.87 against the estate of the late Thomas E. Maloy, head of Chicago L. U. 110, union, who was shot to death on Feb. 4, 1935, was filed recently in behalf of the U. S. government for unpaid income taxes.

The claim listed taxes owed the government and interest on them as follows:

Year	Income Tax	Interest
1929	$3,888.29	$205.28
1930	23,062.92	1,217.96
1931	3,395.93	126.49
1932	38,705.37	2,043.43
1933	25,000.00	1,319.86
1934	1,219.75	63.59
Totals	$94,279.26	$4,976.61
Grand Total		$99,255.87

When letters of administration were issued, Maloy's estate was estimated at less than $2,000.

Trade Press Insists that I. A. Will Forsake A. F. of L.

The industry trade press, particularly *Variety*, insists upon reading the I. A. T. S. E. out of the A. F. of L., their angle being that President George E. Browne of the I. A., in striving for a vertical setup in the picture industry, must necessarily align himself with the industrial union bloc headed by John Lewis, head of the United Mine Workers, who presently is battling with A. F. of L. leaders who favor craft organization.

Repeated official denials on behalf of the I. A. leaders serve only to assure the trade press that the story is true, and they twist all statements made in relation thereto to fit their own viewpoints. I. A. is represented as eager to "grab" all industry workers except musicians.

Seek to Block Random Projection Work

Under the provisions of a bill introduced in N. Y. State Senate, the Civil Service Law is amended to prohibit a public officer or employe from performing service as a projectionist or stage hand in connection with performances given by or for inmates of any state institution unless civil service employes are by occupation or vocation projectionists or stage hands.

New RCA Ultra-Violet Recording A Notable Advance in the Art

REAFFIRMING its position as the leader in the field of sound recording and reproduction, RCA Photophone has just disclosed another extremely valuable and highly important contribution to the art of sound motion pictures through a series of public demonstrations of its new Ultra-Violet, push-pull recording process. Such technical details as are available at present are appended hereto.

This new RCA recording evoked unstinted praise and tremendous enthusiasm from the various audiences of executives, exhibitors, newspapermen and members of the Atlantic Coast Section of the S. M. P. E., before whom it was demonstrated. The process surpassed in quality any recordings over any system ever heard by this writer, being marked by a naturalness, fidelity and complete absence of background noise. The entire frequency range up to 10,000 cycles is encompassed, and it is significant that less than one-half the volume of a 40-watt system was needed to reproduce the recordings.

RCA allotted to itself no easy test of this Ultra-Violet recording, the selections offered including vocal and instrumental renditions (including a piano solo that would lay bare the defects of any system) and finishing up the program with a symphonic orchestral presentation that was a truly magnificent exposition of the worth of the new process in that it reproduced with amazing fidelity such instruments as a harp, tympani, cymbals and bells, all of which issued from the horns with a clarity that was amazing to even the trained technicians among the auditors.

Needless to say, the process did not receive its just due from the general trade press, the representatives of which, although readily stating that it was "wonderful sound," possessed insufficient technical knowledge to accurately evaluate the enormous difficulties involved in producing so magnificent a result.

Puts RCA Far in Lead

Already acknowledged by competent technicians as possessing superior inherent advantages over any other existing method of recording, the RCA process has now taken still another step forward and one that bids fair to render hopeless an attempt by means of other systems to even match its quality, much less surpass it. The RCA variable area system of recording was always considered in informed technical quarters as possible of greater refinement; while the variable density system used by others has probably now reached the limits of its development.

I. P. will present in an early issue a detailed statement of the effects of this new recording process upon reproduction in the theatre, together with data bearing on the slight equipment adjustments necessitated thereby. Notes on the recording process follow:

Recording with the new ultra-violet system is a good deal like improving the details of a photograph. In this case the photograph is the picture of the sound track on the film. In order to get the most faithful recording of speech or music, the picture of its characteristics on the sound track must be as sharp and clear as possible, so that every detail, no matter how small, is uniformly impressed on the film. This is especially important in recording the higher frequency tones (which are the ones that impart realism to the sound) because they are represented on the sound track by finely spaced peaks and valleys.

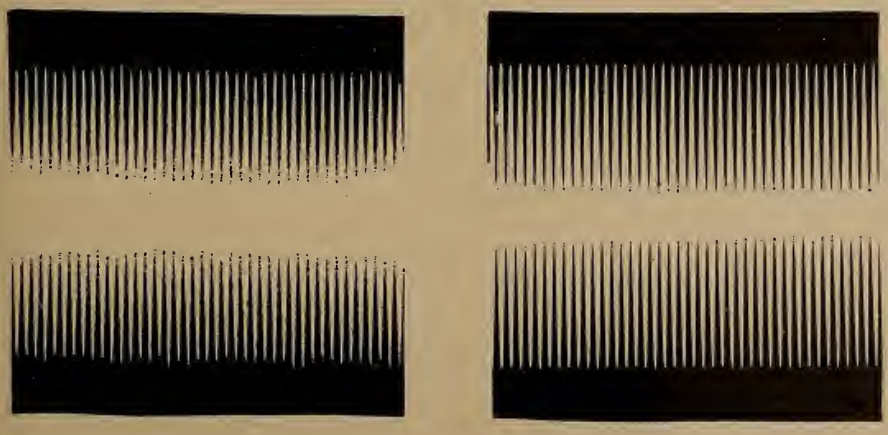
The two most important factors that determine the sharpness of the image on the sound track are: (1) the exact focusing of the lenses, and (2) the penetration of the light which is focused on the emulsion of the film negative.

Ordinary white light is composed of a great many different wave-lengths of light, and it is impracticable to focus more than a small number of these wave-lengths sharply enough at one time. Thus with white light, many of the wave-lengths are somewhat out of focus and blur the edges of the sound image. Then too, some of this light penetrates too deeply into the emulsion, where it is scattered and produces a certain amount of distortion.

What the RCA Photophone engineers have done with the new system has been to interpose an ultra-violet mask in front of the white light which filters out all the wave-lengths but those within a very narrow range. This narrow band of light is in the ultra-violet spectrum and is actually invisible to the unaided eye.

The restricted band of light makes possible much sharper focus of the lenses in the optical system. Also, this same narrow band of ultra-violet light makes it possible to control the extent to which it penetrates the emulsion of the negative. The fine peaks and valleys produced by the high-frequency tones are then photographed sharply and clearly and in the exact pattern of the sound. The same method applied to the printing process, after the negative has been made, permits a much wider latitude in making accurate prints for reproduction in the theatres.

The tendency for the high-pitched voices of some screen players to sound sharp-edged, especially in pronouncing the sibilants, has long presented a difficult problem to sound motion picture recording engineers. The technical reason for these harsh sounding effects, which ruined the chances of many



WHITE LIGHT ULTRA-VIOLET

Sound track of 9,000-cycle frequency tone

former screen luminaries when sound pictures were introduced, is that by ordinary recording and printing methods, the minute variations in amplitude, of which the upper frequency tones are composed, become blurred or distorted in the sound track, so that instead of an exact pattern of the speech characteristics there is merely an approximation. The upper frequencies are the tones which make possible realistic reproduction.

Heretofore, when a high-pitched voice reached the neighborhood of 9,000 cycles, the engineers have found it necessary to cut off the top range of frequencies, or depend upon extremely critical and laborious printing of the final sound track to remove the objectionable rasping effects. The new ultra-violet method gives such a sharp and clear definition of the peaks and valleys of the high-frequency waves on the track, that there are now no practicable limitations in recording and reproducing all the frequencies necessary for faithful reproduction from film.

Practical Theatre Results

To the non-technical listener in the theatre, ultra-violet recording means that the lisping and hissing effects which mar the speaking voices of many of our favorite movie actors and actresses should be completely eliminated, and the quality of musical reproduction brought closer than ever before to a faithful replica of the original.

The new ultra-violet method involves only a few simple adjustments in existing High Fidelity sound recording systems, consisting in the main of an adjustment of the lenses in the optical system for sharper focusing, and in the use of a light filter over an ordinary incandescent lamp, which limits the radiant light energy focused on the film to a narrow band, invisible to the unaided eye. The same method permits a much wider latitude in the process of making accurate positive prints for the theatres.—James J. Finn.

CLEVELAND L. U. 160 PLAN OF THEATRE SERVICING

(*Continued from page* 20)

ever-present mark of a successful organization. The lack of such pride and confidence in one's Local, as the pages of I. P. will attest, has wrought the ruin of more than one seemingly successful outfit.

The reaction of exhibitors to all-inclusive service by a projectionist Union, as stated by Mr. Welman, merely confirms the attitude of exhibitors everywhere after even a short trial period of complete Union service. In Cleveland, as in Cincinnati and in San Francisco, the unions manage to give that extra ounce of attention and service that no itinerant electrics' man could possibly give. The exhibitors are quick to notice this difference.

Confirmation of another I. P. fetish of long standing is had in Mr. Welman's article. I. P. has repeatedly stressed

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the need for competency in any Union servicing undertaking. Lacking that degree of competency attained by the electrics' servicemen, a Union might just as well not bother with this activity at all. Happily, Local 160 service has been frequently demonstrated to be vastly superior to any service the electrics could possibly offer. Ditto for San Francisco and Cincinnati, as recounted herein recently.

I. P. has long since advanced beyond the stage where it advocated Union participation in all-inclusive theatre service as a purely defensive measure against the probable encroachment by the electrics and by other independent servicing groups. It is an open secret that I. P.'s campaign for Union servicing was conceived as a last-ditch means of keeping the electrics in their place and of protecting the small margin of safety enjoyed by Unions prior to January, 1935. That the Alliance would ever embark upon any serious widespread servicing movement was something that I. P. never seriously considered possible.

The Road Lies Open

True, I. P. did run up the flag of freedom from domination by the electrics, and it did advocate that the craft move in and take over work that obviously belonged to it. This procedure was adopted by I. P., however, on the timeless assumption that the best defense was a strong offense. The gag worked: the craft took the bit into its mouth, the electrics were intimidated and scared off, imporant units of the Alliance were launched on an enterprise that should have been undertaken years ago, and Alliance prestige was considerably enhanced through the discovery made by countless exhibitors that the Union represented something else than a mere collection agency for the projectionist over so many man-hours work per week.

I. P. claims no special credit for this job. It merely followed the pattern already cut out by such cities as Cleve-

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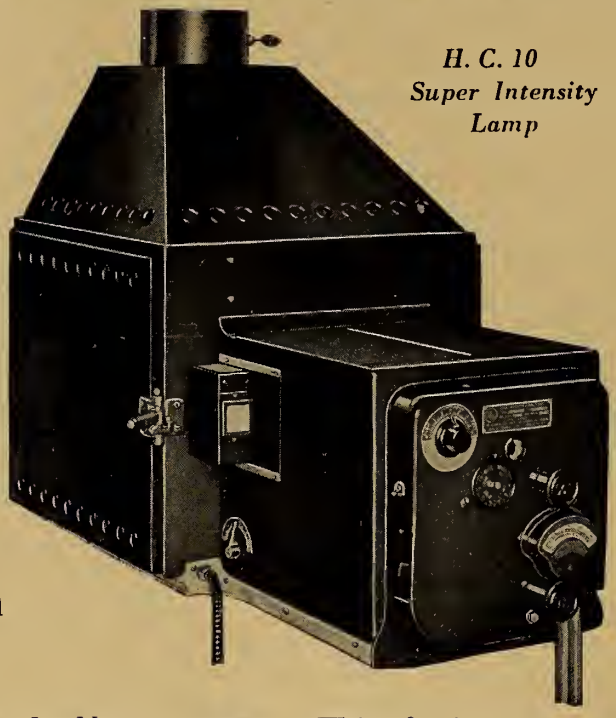
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SOURCES OF D. C. POWER FOR THE SUPREX H. I. ARC

(*Continued from page* 17)

operated from one of his generators would be *exactly the same* as it is when a rectifier is used. Such fluctuations as do occur in a Suprex arc, I believe, are due entirely to the characteristics of the arc itself.

The high-intensity light delivered by the Suprex arc is due to the core material of the positive carbon. The area of this core is very large as compared with the area of the carbon as a whole, the sole function of the carbon and copper-coating being that of a carrier or holder for the core material, which has a long period of carburetion and permits the use of a high current density.

It is a characteristic of the Suprex carbon that the core material burns away faster at one instant than at another, with the result that the crater depth varies *thereby varying continuously the resistance of the arc!* Ohm's Law applies here, the same as elsewhere: the greater the arc resistance, the less current will flow; the lower the arc resistance, the more current will flow—thus the ammeter in circuit will vary continuously.

Now, the greater the ballast resistance in series with such a load, the slower will be the changes in current values at the arc, because the ballast will absorb to some extent the changes,

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the ballast resistance not changing as fast as that of the arc. For example: if the Suprex arc be operated from a 110-volt d.c. source, the ballast necessarily will absorb 77 volts, while the arc takes 33 volts. Inevitably there will be a little fluctuation in the arc because of the enormous amount of ballast in series with it.

However, if a voltage of, say, 42 is supplied, then the ballast will be 9 volts, which is not sufficient to be very effective in removing the fluctuation due to the variation of arc resistance. A rectifier having the identical 9-volt drop, but using reactance instead of resistance, will be just as effective in suppressing fluctuation as would a generator with ballast.

The fluctuations which Mr. Dash ascribes to the power supply (rectifier) just do not exist, except in rare instances. Proof of this can be had readily by merely substituting for the arc another equivalent load which has a constant, instead of a varying resistance, from which it will be noted that the ammeter in circuit will be as steady as can possibly be, irrespective of whether a rectifier *or a generator* is used as the source of power.

Mr. Dash next proceeds to the copper-oxide rectifier, supplying therefor the usual quota of figures and graphs which this writer holds to be incorrect for a properly designed rectifier. After all, we who specialize in rectifiers hardly have to have our design standards laid down for us by any other motor generator man—which Mr. Dash insists upon doing by his rigid adherence to performance records which clearly indicate a rectifier design years behind the progress of the art. The scant attention paid the copper-oxide rectifier by Mr. Dash probably reflects his unfamiliarity with this unit rather than any desire to skip over its obvious advantages.

Getting along, we come to the motor generator section of Mr. Dash's engaging contribution to projection arc power supply. We assume that, despite any specific mention of make, Mr. Dash naturally compiled his generator figures from tests of a Hertner unit. And very flattering to the generator are these figures, indeed.

Here again the figures supplied by Mr. Dash are quite unconvincing and of no particular significance in any impartial investigation of power sources, because again omission is made of ballast. His efficiency figure of 60% is equally insignificant, because by actual tests conducted by disinterested parties the efficiency of the particular motor generator cited by Mr. Dash was found to be 49%.

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In support of this conclusion I bring forward not my own opinion or that of an outside party but an advertising circular issued by Mr. Dash's own company, the Hertner Electric Co. This circular reproduces a letter from the Consolidated Gas, Electric Light & Power Co., of Baltimore, bearing on a test of the Hertner generator made by the power company at the Harlem Theatre in that city. We quote therefrom:

Independent Test Data

"Test from Nov. 12 to Nov. 18, inc., with Peerless Magnarc lamp and Hertner 40-volt generator burning 44 amperes and 34 volts at the arc.

"Test was made with theatre operating for 64 2/3 hrs. for above period.

"Current consumption for above period 218 K.W.H."

Now, the simple mathematics applicable to the aforementioned test is as follows:

$$\frac{218}{64.66} = \text{Watts per hour, or 3371 watts}$$

drawn from the a.c. line per hour.

Watts consumed at the arc were: 44 amp. x 34 volts, or 1496. Therefore the efficiency of the generator was:

$$\frac{1496}{3371} = 44\% \text{ efficiency.}$$

It appears, then, that the efficiency of the Hertner generator during the aforementioned test, which Hertner so proudly proclaims, was 44%; but for the purposes of Mr. Dash's paper before the S.M.P.E. this figure suddenly and strangely became 60%. Mr. Dash acknowledges that the rectifier has an efficiency of 65%; and Mr. Hertner himself, in an article in *Film Daily* for February 1, 1936, also gives 65% as the figure for rectifier efficiency. Both these gentlemen claim an efficiency of 60% for the Hertner generator; but this writer repeats that nothing in the way of facts adduced to date tends to sustain this claim.

Simple Mathematics Applies

All of the foregoing merely goes to prove that efficiencies of the various power supply units is a topic which logically falls within the realm of simple mathematics, and is hardly susceptible to extravagant claims that are not supported by fact—which means by performance records. The only tests that mean anything are those which are conducted under actual projection room operating conditions, on which basis it would be necessary to allow for ballast in a generator.

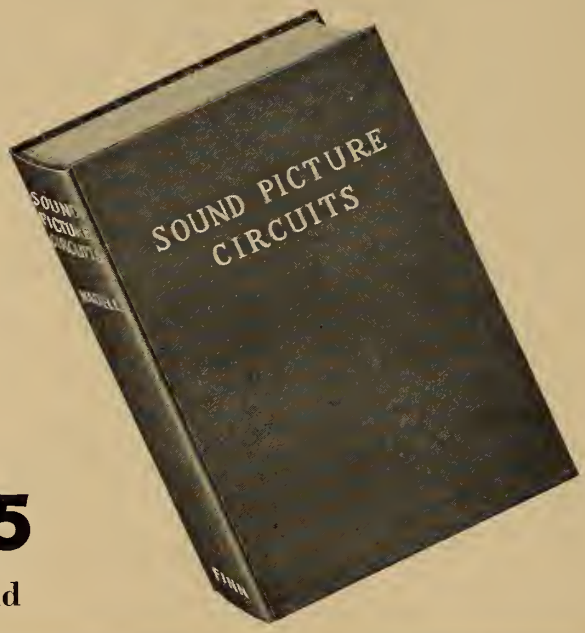
While it is not the function of rectifier mnaufacturers to engage in any prolonged controversy with generator people, it appears that the latter might well keep posted on the development of rectifiers and desist from recent efforts to substitute an outmoded rectifier design for the purpose of making comparative tests. Rectifiers have enjoyed the advantage of an aggressive promotional campaign by their manufacturers, while the generator people sat back and did nothing, evidently feeling that the theatre field owed them support for past favors.

Units Sold on Competitive Basis

Modern rectifiers have been sold on a competitive basis and strictly on their merits. Misinformation about either unit of power supply is distinctly bad business procedure for either group, because ultimately the field always catches up with absurd claims. Moreover, there is no apparent need for any manufacturer to avail himself of any particular publication opportunity to "lay it on thick," so to speak, so long as there exists a medium of contact, such as I. P., for the dissemination of correct operating data.

In fact, the willingness of this publication to publish both sides of any controversial topic makes it unnecessary for any manufacturer to beat his tom-tom in any engineering hall far removed from contact with theatre people, and particularly projectionists, who have to operate the equipments.

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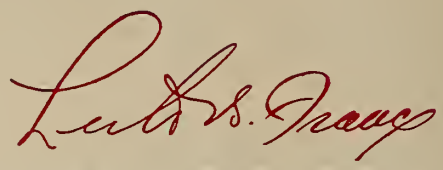
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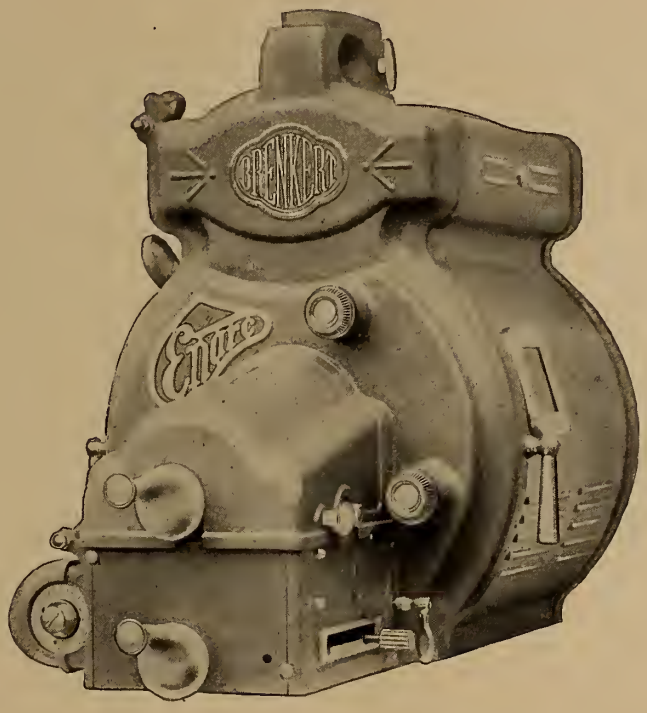
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APR -8 1936

International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

Volume 10 MARCH 1936 *Number 3*

Index and Monthly Chat 5

Wide-Range Reproduction in Theatres 7
J. P. MAXFIELD
C. FLANNAGAN

Motor Generator Efficiency 11
JOHN HERTNER

Function and Application of Sound System Analyzers, II.. 12
A. C. SCHROEDER

Soft Solder: Its Composition and Uses on Wiring 14
LESLIE LINICK

The Editorial Page 15

The Flexible Screen—Are We Coming to It? 16
FRED WESTERBERG

Development of the Shearer Two-Way Horn System 19
JOHN K. HILLIARD

Samuel R. Burns 22

News of the Month 23

News Notes
Technical Hints
Miscellaneous Items

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MONTHLY CHAT

PROJECTIONIST organizations seem to be legislation-mad, locally and statewide, judging by the number of requests for data service reaching us. A word of warning: legislation may be good, bad or just plain inocuous, depending upon who is paying how many legislators how much. Appeals for the passage of "protective" laws may awaken suddenly those legislators who never realized how much "protection" a given group already had, and who immediately seize upon such opportunities as a new source of income for themselves.

The degree of protection enjoyed by any unit, experience teaches, is always a direct reflection of the strength exerted and combative ability displayed thereby. Legislation alone has never made a weak unit a strong one. Legislation is beneficial—but not infrequently we suffer from too much of a good thing. Some of the strongest units in America operate in localities where there exist no restrictive statutes.

Stringent projectionist licensing laws are the only kind that have the unqualified endorsement of I. P. Practically all other laws pertaining to projection can exert as much influence for harm as for good. Caution is the watchword here.

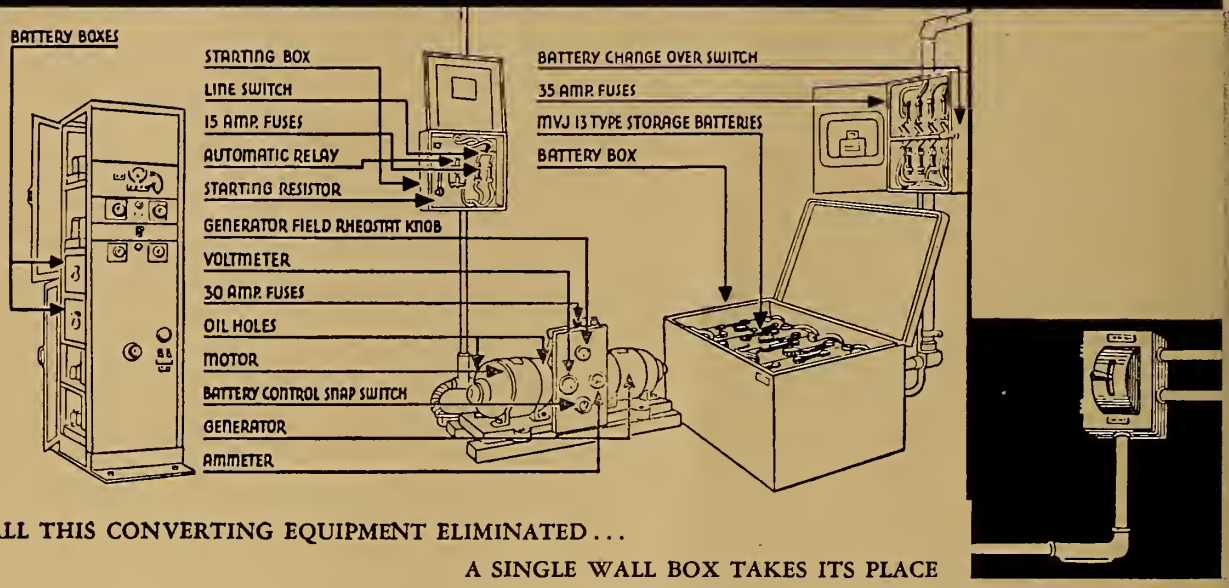
SCREEN images today reflect not only sharp improvement in projection light sources but also a return to sanity in the studios, which have suddenly rediscovered the advantages of "hard" lighting. Even with 150 amperes pouring through, the prints of the last few years had less tone than a mud bank. Some marvelous lighting is coming through from Hollywood these days.

THOSE sections of the craft interested in servicing work have been worrying about sources of sound system replacement parts. I. P. has not heard of any instance where the electrics have refused to supply needed parts even for those theatres on Union service. Sources of supply will be cited direct to any organization upon request.

CURRENT sound reproducing equipment ads cite the advantages of "Ultra-Violet Recording." This is rather a far cry from the public address panels of 1927-28 (which is all sound systems of that day were). This suggests a query: Has the craft kept pace? Every man for himself on this.

SOUND system servicing by projectionist organizations is proceeding at an almost unbelievable clip—except in those territories where years of no opposition has softened up the units and made them quite complacent and smugly satisfied with their world-beater status. What is your unit doing about this situation?

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INTERNATIONAL PROJECTIONIST

VOLUME X NUMBER 3

MARCH 1936

Wide-Range Reproduction Requisites

J. P. MAXFIELD and C. C. FLANNAGAN

ELECTRICAL RESEARCH PRODUCTS, INC.

The problem of wide-range reproduction in theatres is discussed in this paper originally presented before the S.M.P.E., with reference to the amplifier output power capacity; the importance of accurate adjustment of equipment; special installation technic; acoustic diagnosis for positioning of high-frequency, mid-range, and low-frequency units; volume setting; and diagnosis of acoustic treatment of backstage interference.

IN THE early days of sound pictures there were two distinct limitations that prevented any system from achieving complete naturalness: first, a limited frequency range; and, second, a limited loudness or volume range. While there were, of course, other forms of distortion present, they were, in most instances, of less commerical importance than the two just mentioned. From an engineering standpoint these older systems might have been termed "restricted-range systems."

In contrast to these are the "wide range"* systems in which both frequency and volume ranges have been very considerably increased.

With reference to the extension of the frequency range, the data usually presented take the form of a steady-state frequency characteristic. Attainment of a satisfactory curve of this kind is, however, not the only requirement. While it is certainly requisite that all the components of each sound shall be reproduced in their correct amplitudes, it is also desirable that the sound shall be reproduced with the right duration. Resonant elements introduce transients, recognized as a prolongation of some sounds beyond their natural duration, so that they overlap the following sounds, thus distorting quality.

In the present advanced state of the art this is not often so in the electrical design. Such prolongation occurs occasionally in the case of loud speakers of inadequate design and frequently in auditoriums where the backstage area permits marked standing-wave patterns. Such effects impair the performance of the best sound systems. A further requirement is that there be no non-linear distortion, which distortion is evidenced by the introduction of components that are not present in the original sound. In other words, there must be a linear relationship between the amplitude of the input and that of the output in all parts of the system.

This leads naturally to a consideration of the power output of the amplifier necessary to supply auditoriums of various sizes. A considerable amount of work has been done along this line which makes it possible to set the amplifier requirements rather definitely. Fig 1 shows a curve which represents the power output capacity of the amplifier and the cubical contents of the largest auditorium for which this amplifier is regarded as commercially satisfactory with the present loud speakers.

The question of the power required for wide-range reproduction is rather interesting. If a system already installed be modified to permit wide-range reproduction without consideration of the amplifier power capacity, well recorded music will sound slightly louder than it does on the standard system. On the other hand, the improvement in naturalness, brought about by extending the range, leads one to feel that he is listening to the orchestra itself rather than a production of it, and the immediate reaction is a feeling that the loudness is insufficient. It is

*"Wide Range" is the Erpi trade mark for its extended frequency range sound reproducing system.—Ed.

interesting that this improvement in quality appears to transfer the mind of the listener from an artificial standard to the standard of the real original performance.

In view of this effect, it has been found desirable to increase the power capacity available for the wide-range system as compared with the old standard system. In theatres already equipped with systems of the old type, observations were made to determine the adequacy of existing amplifiers before the wide-range modification. It was found desirable in many cases to modify or replace the amplifiers to insure conformance with the requirements shown in Fig. 1. In theatres not previously wired for sound, higher powered amplifiers than would normally be employed in restricted-range systems were installed.

Accurate Adjustment Important

In order to attain the greatest dramatic effect from this improved equipment, it has been necessary to develop a very definite technic of installation. The procedure is of importance, first, in coordinating the operation of the various parts of the equipment, one with another; and, second, in acoustically draping the backstage space to avoid standing-wave interferences.

As a preliminary, a brief statement regarding the equipment may be of interest. The equipment consists, essentially, of the sound-head for translating the sound-track into electrical impulses, an amplifier system to amplify these weak impulses, and a speaker system to translate the electric currents back into sound. The main part of the description will deal with the speaker equipment, although it has been necessary to make improvements in all parts of the system in order that it may be capable of transmitting to the speakers the increased volume and frequency range.

The speaker system differs materially from the earlier commercial theatre types mainly in that there are three sets of speakers, one for the low frequencies, one for the mid-range, and one for the extremely high frequencies. In addition to these three sets of speakers, a network is necessary for splitting the output current of the amplifier into three frequency-bands, one for each set of speakers. The ranges covered by these three sets of loud speakers are approximately as follows:
Low-frequency set .... Up to 300 cycles
Mid-range set .. 300 to about 3000 cycles
High-frequency set .. 3000 cycles and up

It will be seen that a definite problem is found in arranging the system to avoid bad interference within the frequency ranges in which the various sets of speakers overlap. This is particularly true because the electrical network that divides the amplifier output into the three frequency-bands is not of the sharp cut-off type, and therefore permits considerable overlapping of the various sets of speakers. The sharpness of this cut-off, in a commercial system, is of necessity a compromise between expense and effectiveness. The sharpness afforded by this system has been found adequate for good quality, provided the proper installation procedure is followed.

The special installation technic is carried out for the purpose of insuring that the various parts of the reproducing equipment cooperate properly with one another. This technic has naturally divided itself into the following series of operations:

(1) Acoustic diagnosis of auditorium.
(2) Positioning the mid-range horns to afford best sound distribution.
(3) Positioning and volume setting of the low-frequency units.
(4) Diagnosis and acoustic treatment of backstage interferences.
(5) Positioning and volume setting of high-frequency units.
(6) Final check of system on commercial product.

Acoustic Diagnosis of Theatre

If expense were no object, the acoustic diagnosis would be made with measuring instruments. However, it is frequently impracticable to make the necessary measurements, and under such conditions the reverberation time and its frequency characteristic are computed from a survey of the size and shape of the auditorium and from the nature of the floor, walls, seats, hangings, *etc.* This reverberation time becomes the starting point of the theatre analysis.

In the application of the wide-range systems to the theatre, there are other acoustic properties besides the average reverberation time which are of great importance. Again, for practical reasons these effects have been divided into two groups: those caused by the front-stage sound in the auditorium and those caused by the conditions backstage. All discussion of the backstage troubles will be left until later and the present discussion will deal only with the frontstage effects.

These special effects refer to concentrated reflections from large, flat or curved surfaces, such as the back wall, a curved ceiling or dome, the front of a deep balcony, *etc.* As is well known, the reverberation time for satisfactory reproduction lies between two limits which are rather widely separated. In practice, very few houses, if any, are found to be too dead. Therefore, it has been customary to specify these limits as the time of reverberation for optimal reproduction and as the maximal time of reverberation acceptable for commercially good quality. In addition to determining the reverberation time, which is an index of general liveness, the acoustic analysis determines the presence of echoes, "slaps," multiple reflections, *etc.*, from undamped, curved, flat surfaces.

In theatres having such defects, which have not been corrected by acoustic treatment, careful diagnosis by ear, after the system has been installed, frequently permits positioning the loud speakers to minimize the defects. Such diagnosis consists in exploring the whole audience area by ear while reproducing some form of speech with the speakers on the stage. It has been found possible, under these conditions, to locate the so-called "slap" or echo areas; and, in most cases, a visual inspection of the position of the sound-source, the slap area, and the geometry of the house leads immediately to detecting the sound path causing the difficulty.

Positioning Mid-Range Horns

The next step of the procedure, therefore, is to position the mid-range, or horn, speakers in such a manner that their sound is distributed to the audience area without bad interference from echoes and slaps. In the majority of houses, the reverberation time of which lies within acceptable limits, this is possible without additional acoustic treatment. Since the horn speakers are directional to a large

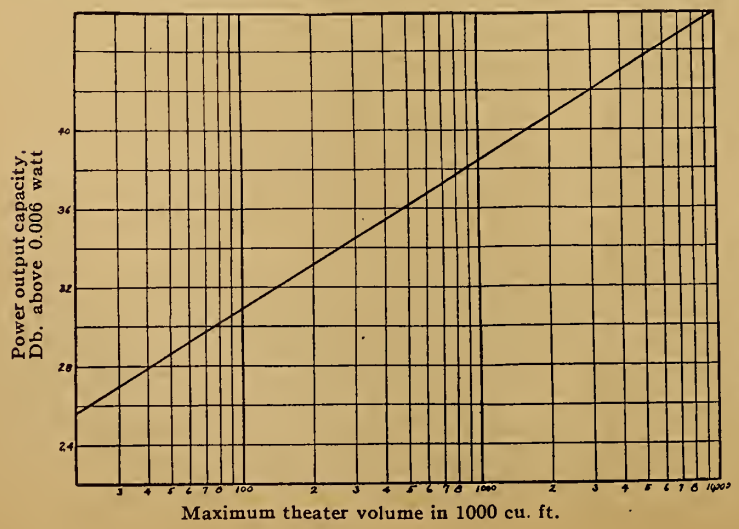


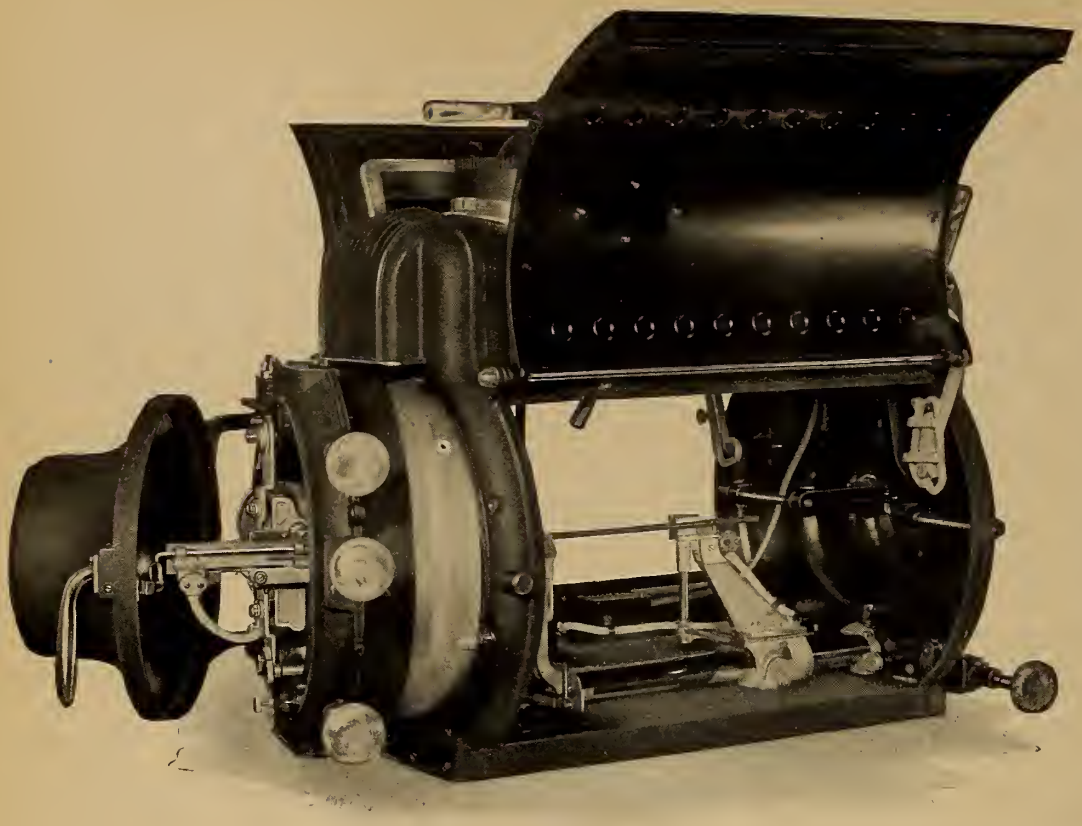
FIGURE 1
Relation between capacity of amplifier and size of auditorium

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WRITE FOR LITERATURE

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degree, it is possible to direct the sound into the audience area in such a manner that very little direct sound from the horns reaches the troublesome reflecting areas. Naturally, in the case of a curved back wall, it is necessary either to sacrifice good sound in some of the back seats or to apply acoustic treatment to the wall immediately above the heads of the audience.

Since the majority of theatres have a higher reverberation time than optimal, and are, therefore, livelier than desirable, the technic of avoiding "slap" by concentrating the sound upon the audience area has automatically introduced an improvement, namely, an apparent decrease in the reverberation of the house. By concentrating the direct sound from the horns upon the audience area, a maximum of direct sound is attained at the listener's ear. In addition, since the audience usually constitutes the most effective damping in the theatre the reflected sound that finally reaches the livelier part of the theatre, to become reverberation, is thereby decreased. For both these reasons, therefore, a house can be made to appear under reproducing conditions, deader than it would be for a real performance for which most of the sound sources are relatively non-directional.

One interesting effect has been noticed in connection with setting the horns, namely, that a much more accurate setting can be obtained by so positioning them, initially, that they definitely include the error to be avoided. They are then angled or moved slightly until this error disappears. This implies that the ear can more accurately determine the removal of an error than the approach to it. Whether this would be true if the recording and its reproduction were perfect is not known, but it is certainly true under the present practical conditions.

The Low-Frequency Units

Now that the horns have been properly set, the next step of the procedure is the addition of the low-frequency units. Early in the wide-range work a phase relationship was looked for between the lower-frequency and mid-range units, and an effect was found that was mistaken for a real phase relationship. The effect of improper relationship is easily noticed, and is disliked by the majority of the public. In the so-called unphased conditions, the sound is distinctly disagreeable; whereas in the so-called phased position, it is said by the layman to be pleasing to listen to.

It has been found that for a horn of a given length there are a series of fore and aft positions at which the baffle may be placed for good quality. This is on the assumption that the mid-range and the low-frequency units are electrically poled identically; that is, that the current supplied to them produces, in both sets of units, movements of the diaphragms in the same direction. If the polarity of

(*Continued on page* 29)

Motor Generator Data

By JOHN HERTNER

HERTNER ELECTRIC COMPANY

QUESTION: "I am running a 110-volt generator, 100-200 ampere capacity, on Suprex lamps using 50 amperes. The manager has been told that this operation is very inefficient. The motor on the unit is marked 25 H.P. I have been told by one party that since this is a 25-horsepower motor, we are consuming 25 horsepower of current; and as our rate is about 3 cents, it is costing 75 cents an hour. Unfortunately, we have all our load on the same meter, so we cannot separate this set from the rest.

"Another party told me that running at 110 volts with the Suprex arc at 33, we are throwing away 77 volts in ballast which, if it were cut to 7 volts using a 40-volt generator, would make our load and costs less than half what they now are. He also told me that the Suprex arc is not as efficient on 110 volts as on 40 because the light is not as steady. Can you give me some help?"

ANSWER: The use of the words "efficient" and "efficiency" is the source of a great deal of argument. Fundamentally, "efficiency" expresses the ratio of what is gotten back to what is put into a given machine; but while a certain piece of apparatus may be very efficient in itself in that the output-to-input ratio is high, producing more than other competing units, it may be delicate and need too much attention; it may be subject to breakdown and hold up the entire production of the plant; it may produce a result which, while quite commercial, does not measure up to the past reputation of the product that is being made—all these cause the very efficient unit to become the cause of lowered plant efficiency.

A lamp may, on account of its design, its mirror, lens, etc., be more efficient than some other lamp, but if it is tricky to keep in adjustment it will pull down the efficiency of the theatre as a money-making plant. Because of the attention it requires and the repair expense incurred, its high efficiency may be bought at a high price.

A 25-h.p. motor carrying a 50-ampere load at 110 volts, or 5.5 k.w., does not consume 25 horsepower. Such a size of generator necessarily takes a little more power than one designed for the job. This set should run about 76 per cent on a 100-ampere load, and 65 per cent on a 50-ampere load. A unit of 50 ampere capacity, 110 volts, and with the usual double rating as those mentioned above, would be about 72 per cent: and a unit to produce 50 amperes at 40 volts will run about 70 per cent efficient. These are test figures, but are not ironclad and represent fair averages.

Now, when running on the 110-volt generator it immediately becomes apparent that the large generator, although equipped with a 25 h.p. motor while the smaller 110-volt machine has a 15 h.p. motor, will deliver 50 amperes at 65 per cent, only 7 per cent less than the smaller which operates at 72, so that the power bill is only 10 per cent more.

The big item here, however, is in the fact that the difference between 33 volts and 110 volts is thrown away in ballast less, so that only 30 per cent of the energy produced is delivered. This means that less than 20 per cent of the energy taken off the line is supplied at the arc when the large generator is used. With the smaller 110-volt generator this figure becomes almost 22 per cent.

With the 40-volt generator 82 per cent of the developed power goes to the arc, and the percentage of the line power that is used becomes 57.

Assembling the foregoing in concrete figures of dollars and cents, a 25-h.p. motor when delivering its full load will consume about 65 cents per hour on a 3-cent rate. When delivering 100 amperes from the generator, the 100-200 unit at 110 volts will cost about 43 cents per hour to run. With a 50-ampere load the cost per hour would be 25 cents. Were the smaller 110-volt unit carrying the 50 amperes, it would cost about 22.5 cents per hour. With the 50-100 ampere, 40 volt set, this would be reduced to 8.5 cents per hour.

But this is not all. Reference to the paper read some time ago before S.M.P.E. by Messrs. Joy and Downes shows that a high voltage source of d. c. does not produce the steadiness in light that results from a low-voltage generator. Hence, the 40-volt unit is not only more economical, but produces better screen results. And with screen efficiency, as distinguished from the electrical efficiency of the generator, goes all that a smooth, uniform flow of d. c. can effect. With a minimum of voltage ripple and freedom from line disturbances, higher efficiency results.

It might be mentioned here that you can get a close approximation of the power consumed by your generator by running it for a period of, say, half an hour with its regular load at a time when nothing else is on and reading your watt-hour meter before and after.

Function and Application of Sound System Analyzer Equipment

By A. C. SCHROEDER

MEMBER, LOCAL UNION 150, LOS ANGELES, CALIF.

II

LAST month we studied a simple analyzer, and we saw how current and voltage measurements were made on a 264 type tube. This was all very simple; but we must now look into things a little more deeply. Thus far most of the tubes in our sound systems have had four prongs; a few have had more. In the future we may have to consider amplifiers with tubes having more prongs than we have been accustomed to, and it is quite probable that we may have to become familiar with the new metal tubes. In such a case analyzers will be a good deal more complicated.

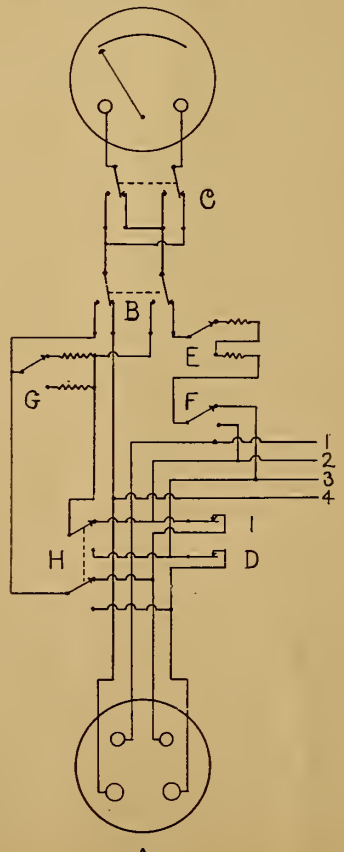
Consider the seven prong socket shown in Fig. 2 last month. The two large holes are for the filament circuit. This is about all we can depend upon. The other holes of this socket may be connected to almost any of the tube circuits, without regard to what circuit the particular terminal may be connected when some other type tube having the same number of prongs is placed in the socket. This has been brought about largely by multiple tubes in one glass shell.

We probably will not have such tubes to worry about; but the analyzer must be made to handle them for the radio trade, so it behooves us to know something about these things. Then, too, should we get the metal tubes, in which even the filament terminals are not the same in all cases, we must know about these angles.

Let us see what this means. In the analyzer shown in Fig. 3 all our voltage tests were made from the negative filament terminal. In the set-up we now want to discuss, we may have to make voltage tests from *any* of the socket terminals. To do this we must be able to disconnect the terminal of the meter that went to the negative filament, and then connect it to *any* of the seven terminals on the socket. If we have this terminal "free," it can be connected to any of these circuits, so we then have a "free reference point".

The reference point is some point in a circuit which we consider as having zero voltage, usually the chassis or the cathode of the tube. After the connection has been made it is usually left there for all the tests made on that tube, or tubes of the same type. There are exceptions, naturally: for instance, some of the tubes having two cathodes. Of course, after having made the tests on one section of this tube, the reference point will have to be changed before testing can be done on the other section—that is, this terminal of the meter is changed so that it connects to the other cathode, unless both cathodes have a common connection. Some tubes use one cathode for the two sections, and obviously the connection is then left.

It may be well to mention that in the directly-heated tube the filament is the cathode, so connection is made to the negative filament for the reference point when d. c. is used. When a. c. is used, the connection ought to be made to the center of the filament, and this is done by connecting the center of the filament winding on the transformer. However, if connection is made to one end of the filament, the testing will be correct.



A

FIGURE 3

There are several ways in which this meter lead can be shifted. All the tube terminals can be brought out to small jacks, and the two leads from the meter are brought out to flexible cords with tips on their ends. It is only necessary to place the cord tips in the proper jacks. This method also does away with the necessity for a polarity-reversing switch, since it is only necessary to reverse the leads in the jacks to make the meter read correctly.

If the analyzer is constructed so that this negative meter lead is changed by means of a switch, it will be the same as the switch F in Fig. 3, which was used to read the voltages of the different circuits. This second switch will be placed in the *negative* leg of the meter, the blade connected toward the meter and the contacts around the switch connected to the various tube circuits, the same as the contacts of switch F. In other words, from the plate contact of switch F there will be another wire going to the plate contact of the new switch, and also wires going from the grid and the two filaments to similar terminals on the new switch. Actually, of course, the blade of this additional switch will go to switches B and C before getting to the meter.

Before going further we might consider what is probably the simplest form of analyzer. It may even be stretching the point to call it an analyzer, but it does perform the functions of one, or at least of some of them. It consists of an oblong block of insulating material, about 2 inches by 3½ inches in size. The center of this block is a socket, and around this a number of pin jacks are incorporated. A cable is a part of the device, the other end having the usual plug attached to it. If I remember correctly, there is

only one pin jack for each of the filament terminals, but all the other terminals are connected to two jacks. Normally the two jacks are connected together, in series.

Consider the two in the plate circuit for example, as shown in Fig. 4. The wire on the left is in the cable; it goes to the first jack and continues on to a switch, the other end of which is connected to the second jack and also to the plate connection of the socket. The switch is so arranged that it is normally closed, and is opened when the tip of the test lead is inserted in the second jack. This opens the circuit between the two jacks and, in effect, opens the plate circuit of the tube at this point.

If the tip which we inserted in this jack is connected to a milliammeter, and the other lead from the same meter is placed in the first jack, we have placed the meter in series in the plate circuit across the open switch, and it will now read the plate current. The same holds true for the other tube elements, except the filament. If the meter reads backwards, the leads are reversed in the jacks.

For voltage readings one terminal of the meter is placed in the first jack, the other terminal being placed in the filament jack, and the needed information is obtained. Notice that the first jack is used, because then the connection is not broken in the plate circuit. Had the pin been placed in the second jack, it would not have been connected to the live part of the circuit. It would have been hooked to the plate of the tube alright, but the plate is on the dead side of the open switch.

Even if the device were so arranged that the first jack opens the switch, the test lead must then be placed in the second jack. Under these conditions, placing the meter terminal in the first jack would connect the meter to the hot part of the circuit, but the plate would not be drawing current, due to the open circuit; thus, while we would get the voltage of the plate supply, we would not get the voltage at the plate when the tube is operating.

Grid Voltage Readings

The same thing is again true in taking grid voltage readings, if the grid bias is obtained through the drop in a resistor in the cathode circuit of the tube. Fig. 5 shows such a circuit and is similar to that of the 42 or the 43, although only one tube is shown. It will be seen that the drop in the resistor A is due to the flow of plate current through it, going from the filament winding, through A, and then to negative of the B supply. If the plate current changes, the drop across the resistor changes in proportion, which of course, changes the grid voltage. Opening the grid circuit at X causes such a change in plate current, so that the reading of the grid voltage under these conditions is almost meaningless.

The next step is to get some information on tubes. With your newly acquired analyzer you may make a few tests and find that the voltage on the plate of a certain tube is 300 and that the current is 50 mils. But what does it mean? Is it good, bad, or something else? Will it even work under these conditions; or if it does, will it be ruined or it will ruin other parts in the amplifier? Unless one knows *about* what the voltages and currents of the various tube elements should be, the analyzer will do you little good.

Many of the tubes come with a chart showing what the operating values should be. This is a good source of information, but it is only a guide. The filament voltages and currents are the exception, and they must be very close to the values recommended by the maker. The plate voltage on the 264 tubes is 90, that is, the battery voltage, assuming that batteries still are in use. Now you plug in your analyzer in the Pec amplifier and you read the plate voltage on the first tube. It will probably be around 50. If it were 45 volts, there would be nothing to worry about. Should it be as low as 40 volts, there would be some doubt.

The point is that one must know *about* what the values should be. The batteries are 90 volts, and if you expected 90 volts at the tube socket and got only 50, you would say, "There is the trouble", and would proceed to rectify it. That which you actually would do for this would be wrong and you would be getting in deeper and deeper. This actually happened here in Los Angeles; but before trying to find out what was wrong the boys obtained competent advice, and they were glad to learn that everything was OK.

You have doubtless guessed the cause of the difference in voltage by this time: it is the resistance in the circuit. Let us look into this a little further, because the better one understands these things the easier it is to apply this information.

Resistors used in amplifiers are usually

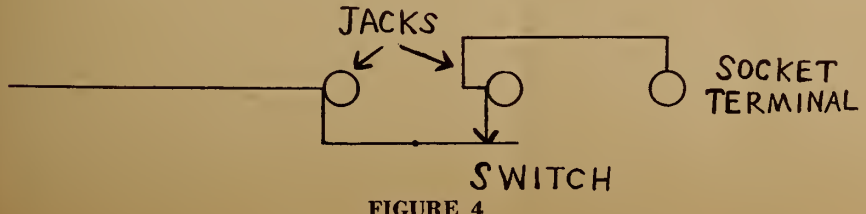


FIGURE 4

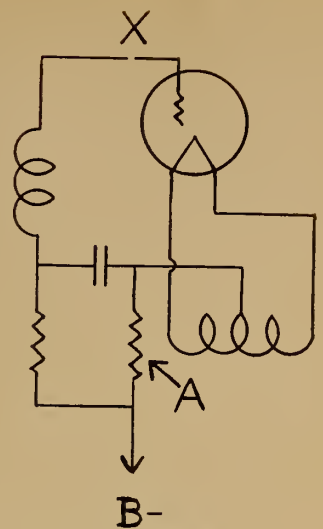


FIGURE 5

within ten per cent of the value they are supposed to be—that is, a resistor that is supposed to be 37,500 ohms may be anywhere from about 33,700 to 41,300 ohms. When the plate current of 1 mil. flows through 33,700 ohms it produces a drop of 33.7 volts across the resistor. Now, 1 mil. flowing through 41,300 ohms will cause a drop of 41.3 volts. Here we have a difference of 7.6 volts, due to just a possible variation in resistors.

Other Important Variables

In fairness, we must not consider this as the whole truth because there is other resistance in the circuit besides the coupling resistor, the tube accounting for a big chunk. Also, the plate current will be greater with 33,700 ohms in the circuit than it would be with 41,300 ohms, thus reducing the difference in voltage under the two conditions. Consider this again: if 1 mil. were the current when 33,700 ohms were in the plate circuit, then the current would be somewhat less than 1 mil. if the resistance were increased to 41,300 ohms. In the latter case the drop would be slightly less than 41.3 volts, due to the smaller current through it.

The tube itself is another variable. Not being all alike, some tubes draw a trifle more or less current than others. A tube that draws a greater current will produce a condition where the drop through the coupling resistor will be greater than it would be with a tube which draws a smaller plate current.

Now, let us suppose that the resistor in one of our Pec amplifiers is about 41,300 ohms and that the tube it feeds draws a trifle more than 1 mil. under this condition. In the other Pec amplifier the resistor happens to be at the other extreme, 33,700 ohms, and the tube is old, not drawing the current it should, maybe .8 or .9 mil. In the first case the drop in the resistor will be more than we had calculated previously, while in the second instance the drop is much less than our former minimum. In other words, the

voltage at the tube under one set of conditions is 90 minus something like 42, or 48 volts. In the other case it is 90 minus about 27, or 63 volts at the plate. There we have a difference of 15 volts, due to just two "variables."

We know that the plate current changes as the bias on the grid is changed, and this tube gets its bias through the drop in a resistor in the filament circuit. Of course, this resistor is just as liable to be off in value, and to the same extent, that the plate coupling resistor was. If the value is too high, the bias is proportionately high, and *vice versa*. Here we have a condition causing still more deviation of the voltage at the plate (Fig. 6).

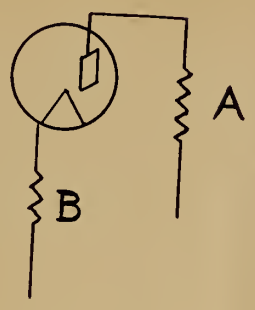


FIGURE 6

You may not have the filament current at exactly 300 mils.; the meter is probably off a few per cent; the zero adjustment may be off a bit to boot, and the analyzer may be off a trifle. Add to this a possible variation in the voltage of the Pec batteries, and then see how near the two plate voltages would be if all these things were in such a direction as to make the one voltage higher, and in the other amplifier all the variables were so that the voltage would be reduced.

Periodic Tests Helpful

Yes, we have been looking at the worst of it, these things all being extremes—and cumulative. As a rule, some of these would be in a direction tending to offset some of the others, but they *may* all be as we have considered them. Unless we are aware of these possibilities, our first use of an analyzer may be confusing, to say the least, and will lead us down the wrong path.

The thing to do is to make measurements from time to time, when everything is as it should be, and record the results. One then has something definite to go by, unless some radical change is made in the equipment; and if such is the case, make new measurements and record the results. Not only does this give us ammunition to use in the event of trouble, but is in itself an education and proves more interesting than imagined.

Might I whisper: "Make a chart of your readings"? I thought I had said all there was to say about charts some time ago, but here are new possibilities. I know a number of the boys who are doing just that at present. If they should have trouble, they will know that the voltage at the plate is 52½ with a tube that draws a fraction more than 1 mil. when the Pec batteries read 91 volts; and that if the voltage at this same place is off a trifle, the trouble is not here but elsewhere.

Well, we did not get to cover all the ground this time that I had planned, but the rest of it will keep, so I'll worry you with it next month.

(To be continued)

Soft Solder: Its Composition and Uses on Wiring

By LESLIE L. LINICK

MEMBER, CHICAGO PROJECTIONIST LOCAL UNION 110

THE best of the common soft solders for joining copper wire contains by weight approximately 63 parts of tin and 37 parts of lead. Good commercial solders contain 60% of the former to 40% of the latter and are generally suitable. The best commercial flux is powdered colophony (a technically pure rosin).

The most important technique in soldering consists of heating the surfaces to be covered sufficiently above the melting point of the solder to cause it to flush or run freely, after which the heat should be immediately withdrawn. This method practically eliminates porous joints. Under no consideration should the solder be heated ahead of the basis metal, or partial oxidation and subsequent destruction will result. On the other hand, the metal, while heating, should be protected against oxidation by previous application of flux.

The purest constituent metallic components of soft solder give a slightly higher electrical conductivity, but the difference is too small to be of any practical importance on lap joints. All soft solders increase slightly in conductivity on aging at ordinary temperatures.

Conductivity of Solder

The matter of conductivity of solder is of much greater importance when used as contacts, for instance, on the end of tube-prongs. For this purpose research had definitely shown that common soft solder is not suitable, first because the surface of the solder tarnishes and thus noticeably increases in electrical resistance; secondly, the impact strength of soft solder of the tin-lead type, or its resistance to the pressure usually met with under the conditions of interest to us, is low enough to permit the solder to change its shape and eventually crystalize.

Proportions of New Solder

Some years back the writer developed a solder containing a small amount of silver of the "sterling" type (which contains about 7½% of copper). While a great improvement, it was found that copper was detrimental and pure silver was substituted with better results. The latest and best composition, however, also employs cadmium, which as an alloy seems to prevent all corrosion and has a lower melting point than the silver alloy. The only easy way of introducing silver and cadmium is by electro-deposition of, first, cadmium, and then silver on the tin-lead alloy. The whole is then melted with rosin as a cover-flux. The suitable proportions, by weight, are:

Tin (free from copper) ..	61 parts
Lead	37 "
Fine silver and cadmium, each	1 "

This solder is sufficiently hard and tough to withstand abrasion and will neither tarnish nor change in conductivity. Its melting point is slightly higher than standard soft solder. Colophony is the proper flux, although any other soft solder flux may be used if the area is well neutralized thereafter by the judicious use of 10% sodium bicarbonate solution and subsequent rinsing with water. At present we are plating the 61/37 alloy in a silver-cadmium alloy bath and have every expectancy of complete success.

A. T. & T. Coaxial Cable OK; Use to All Granted

Permission to construct a coaxial cable for experimental television work between New York and Philadelphia has been granted to A. T. & T. and the N. Y. Telephone Co. by the Federal Communications Commission. Actual construction work must begin by July 1.

Restrictions Anent Time, Use

While many of the restrictions originally imposed by the Commission have been lifted, it is stipulated that the cable should be open to those radio companies interested in experimenting therewith. Since RCA and others are almost certain to avail themselves of this opportunity, it is doubtful if A. T. & T. will accept the terms of the authorization.

The I P EDITORIAL PAGE

Vol. 10, No. 3 MARCH 1936

The Wide Screen Emerges From Hiding

Fred Westerberg of the erudite cameramen on the West Coast is represented in this issue by an article which promotes the cause of the wide screen. Mr. Westerberg certainly knows his emulsions, cameras, lenses and quite a bit about projection; but we just can't get away from the impression that his wide screen thesis is inspired by a feeling that the artistry of his colleagues is hopelessly restricted by present screen proportions. More to the point, this valued contributor seems to forget that the results of our last wide-screen foray still haunt not a few producers and equipment manufacturers. Present screen proportions may be referred to contemptuously as a "postage stamp," but we could never quite appreciate a 54-feet screen image of an intimate love scene or of a majority of the interior shots which comprise an overwhelming number of picture sequences today.

Not a few large theatres now utilize Magnascope for all or a part of the news reel, and not infrequently there comes along a picture like "The Crusades" which shrieks for wide-screen treatment of some of its thrilling sequences of large scope. Such interludes undeniably are emotionally satisfying; but the return to standard proportions unfailingly leaves this onlooker quite cold and clammy. Ditto for color sequences which are followed by black and white.

Mr. Westerberg's artistic sense may ultimately be gratified; certainly the technical requisites thereof are not impossible of attainment. The hardest task confronting our distinguished contemporary in this instance is that of convincing those who, burned badly the last time out, will evermore develop severe chills at a mere mention of the words "wide screen."

The Progress of Colored Motion Pictures

I. P. readers think of color motion pictures in technical rather than economic terms, in sharp contrast to the Hollywood crowd which thinks in terms of neither. The technical advances of color in the last few years are too well known to need recounting here; and the economic aspects of the situation have been detailed herein upon several occasions. Color still has to prove its case at the box-office, despite the flamboyant distributor advertisements which cite the key city "clean-ups" scored by such releases as "Becky Sharp" and "Trail of the Lonesome Pine." The former, costing about $1,500,000 to produce, was a box-office flop; but the low cost of "Pine" (certainly not more than $600,000) insures a healthy profit for all concerned.

No evidence has yet been forthcoming to prove that "Pine" would not have done equally as well without color; which comment induces a restatement of opinion that there never was a color picture which could compare in terms of photographic values with a clean-cut job in black and white, properly lighted all around. Motion pictures being an artifice in themselves, we could never see the reason for piling thereon still another artifice, such as present-day color.

What about the projection of color pictures? Some few years ago the producers of color pictures were seriously concerned about the projection of their product. First-run de luxe theatres always did a creditable job in this respect; but the subsequent-run theatres, unable to do justice to even black and white, made a terrible mess of color projection. Today this situation is materially improved. The influx of about 3500 Suprex arcs has raised the level of illumination throughout the field, although there have been whisperings that this type of arc is not quite right for good color projection. However, the quality of light is less important than the quantity, as far as color is concerned at the moment, and there can be no doubt that a Suprex arc delivers quantity plus. This might make for an interesting research job by either or both the carbon companies and the lamp manufacturers.

By and large, projection today need not offer excuses for poor reproduction of color, and the situation seems headed for steady improvement all along the line. The optical people have a few surprises up their sleeves, for both production and projection purposes, and the lamp and screen people may be counted upon to utilize these advances to the utmost. Color pictures today are strictly on their own, bereft of any alibi for possible failure to attract box-office support.

As far as Hollywood is concerned, we prophesy that more than one producer, victimized by the terrific color lobby which has already lined up more than 14 full-color features for next season, will be badly burned by the time all the tally sheets are in.

Suprex Lamp Magnification Ratio

Numerous complaints have been received relative to the extreme difficulty encountered by projectionists in holding the Suprex arc spot on the aperture. Several complainants insist that the magnification ratio of these lamps is incorrect, which charge seems warranted in view of the operating difficulties experienced. This is a serious charge, because if the magnification ratio is incorrect, one can only assume that the manufacturers know about it. I. P. has been aware of this difficulty for sometime and has discussed the matter with practically all the manufacturers. The answer in each instance was almost identical: "Positively not on our lamps. Why, our spot is bigger than X's, Y's or Z's, and nobody complains about them."

Well, I. P. has complaints about *all* makes of Suprex lamps. The reason for this shortcoming immediately suggests itself: practically all lamps are sold today on competitive test, the results of which are invariably translated in terms of *quantity* of light. This being so, it is obvious that each manufacturer is concerned primarily with pouring light *through the center* of the aperture, which attainment naturally calls for as small a concentrated light spot as can possibly be obtained. From this point on the rest of the story is so plain as to require no elaboration.

Projectionists are infinitely less concerned with *why* this condition exists than with *what* shall be done so that it shall not persist. I. P. is powerless to force recognition of this defect and can only serve as a mouthpiece for the craft in expressing its opinion. If the manufacturers choose to run the risk of casting this splendid arc type into disrepute with the craft, that is their business. We shall see what we shall see.

The Flexibl

We Coni

By FRED

TECHNICAL EDITOR,



G. A. CHARLES, SIGNAL CORPS, U. S. A.

No. 1. 1 x 2 Screen Proportion. This picture illustrates a type of scene for which the wide screen is appropriate.

Our Hollywood colleagues, the (sometimes) uppish cameramen, have long been dissatisfied with present screen proportions on the ground that their artistry is stifled. One of their number, Fred Westerberg, ace cameraman and all-around technician, advances in the accompanying article a reasoned appraisal of the difficulties attendant upon a change in existing standards.

WHO can forget the tumult over wide screen pictures that arose in the late twenties, waxed feverishly for awhile and then suddenly died? Now, it is just barely possible that with confidence and optimism returning to the land, something may be done in the near future to revive this ailing giant, the wide screen.

Before such activity gets under way it may be well to take stock and observe just where we stand. Let us ask ourselves a few pertinent questions. What. for instance. do we hope to achieve by using the wide screen? What errors have been made that we can rectify? What methods are indicated for attaining wide screen pictures? Are any of these methods feasible?

The motives behind the development of the wide screen in the past can only be surmised; but the apparent reason was quite evidently to exploit the box-office value of the big screen for its own sake. Whole productions were cast on the screen in this heroic mold, but the response was not as great as anticipated. The effect of mere size was like listening to a fusillade of brasses in a Wagner opera: very stirring for awhile but hardly to be endured for any length of time without soothing interludes of quiet harmony by the strings and wood-winds.

The logical conclusion to be drawn is simply this: that a motion picture production to be effectively presented in all its moods should not be all wide screen. In fact it would be better if it were not all shown on the normal screen either. The ideal screen. in other words, would be flexible in order to make use of the most suitable screen proportion at any one point in the story.

The bulk of the scenes perhaps would be served best by the normal screen. The problem in most cases is one of height rather than width. In order to read facial expressions the heads must be as large as possible without cutting off the vital action near the bottom of the picture. That is the reason why tables and desks are so often raised and put on blocks for the close shots.



ELMER FRYER

No. 2. Screen Proportion 3 x 5. This still allows larger heads of people in a group, clearer expression and greater effectiveness to the screen.



CARL DAY

No. 3. 3 x 4 Screen Proportion (Present Standard). The important requirement is to include in the picture the girl's rounded knee as well as her face. A matter of height rather than width, so we stay with the regular screen proportion.

Screen—Are

g To It?

TERBERG
TIONAL PROJECTIONIST



ALEXANDER KAHLE

No. 4. 1 x 2 Screen Proportion. A wonderful photographic shot that tells its own story; the human figures but add a touch of life. Only the wide screen could do justice to a scene of such scope and magnitude.

On the other hand, as the distance from the subject is increased, the point is usually reached where the problem becomes one of obtaining as much width as possible, as far as the set is concerned, without dwarfing the actors. A typical example of this kind of a scene is one in which two people at opposite ends of a table must be included in the picture at the same time. Such a scene to my mind would be greatly improved by the use of about a 3 x 5 screen proportion, which would permit the camera to be moved in closer than would otherwise be possible. Interesting possibilities here.

Then we come to the spectacular episodes that cry out for the wide 1 x 2 screen proportion. Imagine great displays of pageantry, battle scenes, revues —in fact any stirring action on a large scale presented in full orchestration on such a screen!



DAVID RAGAN

No. 5. 3 x 5 Screen Proportion. By using a medium wide screen proportion one is able to get the door into the picture without having to move the camera so far away from the action.

Can there be any doubt that the wide screen has a destiny to fulfill? But now comes the rub. How are we going to accomplish this desired advancement in screen technology?

Possible Solutions of Problem

There are two principal avenues of approach to this problem. One is to work out a method utilizing the present standard 35 mm. film; the other is by adopting a new and wider standard film.

One way to obtain wide screen pictures by using 35 mm. film would be to adopt a projection aperture .400 x .825 of an inch (Fig. 1) and use a projection lens having two-thirds the focal length of the normal projection lens. The normal height of the screen would thus be maintained, and 50 per cent would be added to the width. The screen magnification would be increased by 50 per cent and the brightness of the picture reduced about 55 per cent.

Due to the changes required in projection, all sequences intended for wide screen use would have to be segregated in separate reels. In photographing these sequences it would be necessary to compose the pictures so that they could also be projected in the ordinary manner, since all theatres might not care to undertake wide screen presentations under these adverse conditions. The answer to this method of obtaining wide screen pictures is obvious—a headache for all concerned.

Another method of utilizing 35 mm. film would be to abandon the present standard aperture and adopt about a .431 x .868 of an inch wide screen camera aperture as a basis. The medium wide and normal picture proportions could be obtained by matting in the sides (Fig. 2).

The focal length of projection lenses would have to be reduced by one-third. The screen magnification would be 50 per cent greater than at the present time.



DONALD MacKENZIE

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The Flexible Screen—Are We Coming To It?

By FRED WESTERBERG

TECHNICAL EDITOR, INTERNATIONAL PROJECTIONIST



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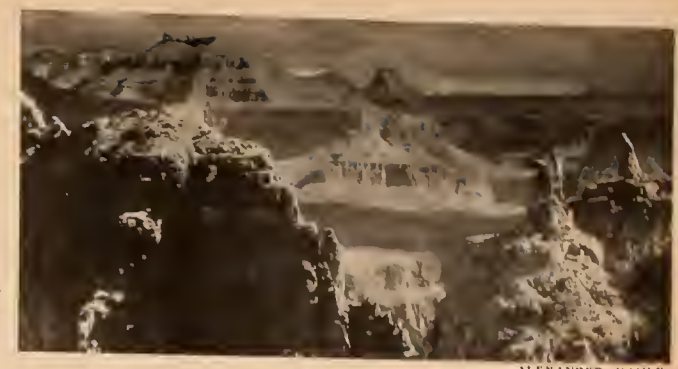
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The focal length of projection lenses would have to be reduced by one-third. The screen magnification would be 50 per cent greater than at the present time.

No changes would be necessary, however, in order to show the various screen proportions, as the height of the frame would always be the same. The screen magnification would therefore be constant, as would the picture brightness.

This method seems to be quite feasible in all respects except that of photographic quality, which would inevitably suffer due to the high screen magnification required. However, as a last desperate effort to retain 35 mm. film, it is at least worth a trial, in spite of the agonized cries which are likely to arise from the cinematographers.

We come now to the question of actually widening the film. Here of course is the happy hunting ground for cinematographers and technicians who see a chance to achieve their hearts' desire as far as the technical quality of their output is concerned.

Intermediate Film Size

We realize now that 70 mm. and other gargantuan film sizes which were tried out in the boom days were unnecessarily large and costly to utilize and represented far too great a departure from the existing standard film to warrant the adoption of any one of them as far as a new standard. For what we seek is after all a new standard film and not just a special film for wide screen pictures.

It seems to me, therefore, that a more conservative approach is indicated. As a tentative proposal I would suggest a film about 2 inches wide, or just enough to attain a 1 x 2 picture proportion (plus allowance for projection angle) and still retain a height of four sprockets (Fig 3).

The magnification required in projecting such a film would be about 15 per cent less than is needed to project existing pictures, which should be ample insurance that photographic quality would be maintained and even improved.

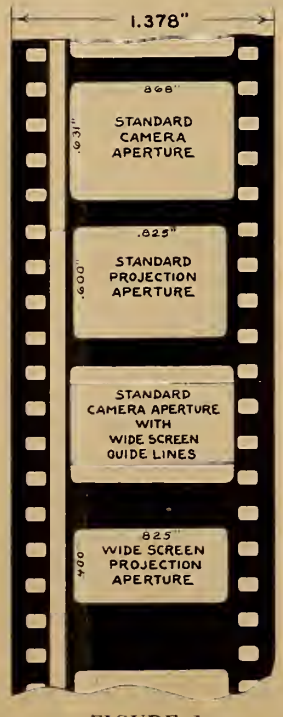


FIGURE 1

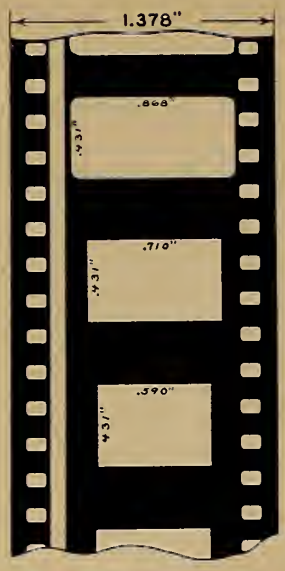


FIGURE 2

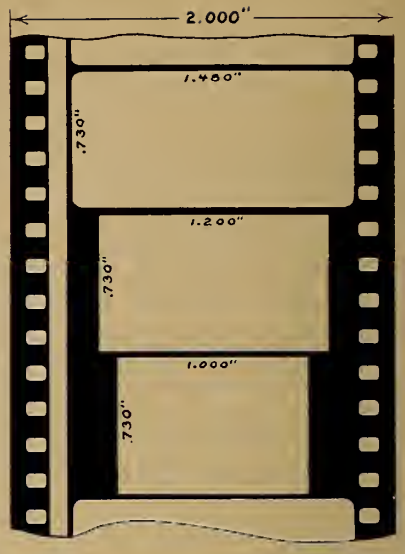


FIGURE 3

Since the height of both normal and wide screen frames would be the same, no changes would be required in order to project either one. The change from one proportion to another could be made at any time on the same reel of film. The same lens would project all scenes, therefore the magnification and the picture brightness would also remain constant.

Tremendous Difficulties Involved

We cannot, of course, ignore the difficulties involved in making a fundamental change in the film size. The fact that all cameras and projectors would have to be replaced or rebuilt to accommodate the increased width between the sprocket rows is one great hurdle that is barring the way. Such a change, world wide in scope, could not be accomplished suddenly. There would have to be a transition period during which both the old and the new film would be used. Projectors would have to be built that could project either film. This requirement should not be hard to meet, however, if the new film retains the essential features of the old, *i. e.*, the same sprockets, the same sound track and the same speed through the projector. Another requirement of the transition period would be to furnish 35 mm. prints to theatres not yet equipped to show the new film.

Yes, the problem is difficult, but will it not have to be faced eventually? The inherent possibilities of the wide screen are too great and the eventual need of an efficient broad gauge film is so inexorable that neither can be dismissed with a shrug. The prospect is not too remote that some particular group will take the initiative, as usual, if Hollywood fails to exercise the cooperative leadership which is expected of it in a case of this kind.

Academy Technical Awards for 1935 Studio Work

Scientific and technical awards granted by the Academy of M. P. Arts & Sciences are as follows: To

M-G-M Studio for the development of anti-directional negative and positive development by means of jet turbulation, and the application of the method to all negative and print processing of the entire product of a major producing company.

William A. Mueller of Warner Studio for his method of dubbing, in which the level of the dialogue automatically controls the level of the accompanying music and sound effects.

Mole Richardson Co. for their development of the "Solar-spot" spot lamps.

Douglas Shearer and M-G-M for their automatic control system for cameras and sound recording machines and auxiliary stage equipment.

Erpi for their study and development of an equipment to analyze and measure flutter resulting from the travel of the film through the mechanisms used in the recording and reproduction of sound.

Paramount for the design and construction of the Paramount transparency air turbine developing machine.

Nathan Levinson, Warner Brothers, for the method of inter-cutting variable density and variable area sound tracks to secure an increase in the effective volume range of sound recorded for motion pictures.

Photographic Quality Advanced

The judges granted a certificate of merit to Agfa-Ansco for their infra-red film, use of which results in a significant improvement in photographic quality and increased facility for making transparency and effect shots. A certificate also went to Eastman for the Eastman Pola-Screen, which is in effect a directional light filter to be applied to the camera.

Development of the Shearer Two-Way Horn System

By JOHN K. HILLIARD

TRANSMISSION ENGINEER, SOUND DEPT., METRO-GOLDWYN-MAYER STUDIOS

This comprehensive discussion of the engineering of theatre loud speakers, relating to the development of a new speaker system, is a most important contribution to the literature of the art of sound pictures. It is presented herein through the courtesy of the Academy of Motion Picture Arts & Sciences, which holds the copyright. Significantly, this entire development was the work of West Coast studio technicians.

THE art of sound reproduction in theatres is now about eight years old. During this time there has, of course, been considerable improvement but only one major change in the standard theatre installation. This change was the adoption of the "Wide Range"[1] (Erpi) and "High Fidelity" (RCA) systems after 1933. The principal modifications involved were: First, a partial fulfillment of greatly needed increase in amplifier carrying capacity; second. the adoption of speaker systems which provided for the division of power between two or more groups of speakers, each operating over a limited frequency range; third, improvements in the sound head which reduced flutter.

While these improvements considerably raised the standard of reproduction in the theatre, it was felt that the speaker system still constituted the principal limitation to naturalness of reproduction. An investigation was accordingly made to determine whether a speaker system could be developed which would economically replace the present systems while providing the much needed increase in fidelity. This was found to be the case, and it is the purpose of the present paper to describe this system and the results obtained with it, and to compare it with previous systems.

Since it was not known how great a departure from a full-range linear response could be tolerated for the purpose in hand, it was considered advisable to start with a system as near this as so far achieved even though the form of apparatus available by its size and cost would prohibit its use for theatre installations. From this it was determinable how much deviation was allowable and necessary in order to obtain a commercially practical system.

Specifications of System

Such a linear system was made available[2], and a series of tests led to the following specifications which were found to be adequate for theatre reproduction, taking into consideration further developments in recording which may be expected within the next few years.

Flat Overall Frequency Characteristic. The system shall not deviate by more than plus or minus 2 db, from 50 to 8000 cycles over the entire angle of distribution within ten feet of the mouth of the horn.

High Electro-Acoustical Efficiency. It shall approach fifty per cent in order that the required amplifier capacity may not be too great.

Volume Range. The volume range shall be at least 50 db, and preferably 60.

Reasonable Cost.

Absence of Transient Distortion and "Fuzziness." The electro-acoustical transducer shall be of such construction that it shall not generate objectionable harmonics up to the peak power required, and the phase delay between units shall be such that the sound will be equivalent to that coming from a single source.

Suitable Angular Distribution Characteristics. The sound shall be radiated through a horizontal angle as great as 110 degrees and a vertical angle of 60 degrees with nearly uniform response at all positions.

Reasonable Compactness and Portability. Low weight.

Amplifier Capacity. The installed amplifier capacity shall be such that one acoustic watt per one thousand square feet of floor area can be delivered when the auditorium is adjusted for optimum reverberation time.

A system which will conform to or exceed these specifications has now been developed, and can be constructed at moderate expense.

In order to take advantage of these characteristics it has been found that when film is reproduced over a system such as this, it is necessary to keep the flutter from the sound head no greater than 0.1 per cent. Although the problem of flutter has been satisfactorily solved, and heads are commercially available which will pass the 0.1 per cent flutter specifications, it should be pointed out that by far the largest majority of heads in use today will not meet this specification.

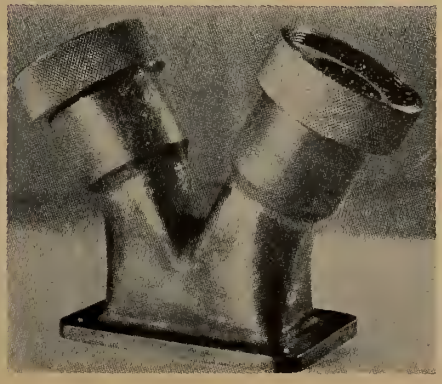


FIGURE 1
The "Y" throat

Power Frequency Requirements

The history of the electrical reproduction of sound has been one of continual increase in amplifier carrying capacity, and in this respect the theatre installation is no exception[3]. Originally, output powers from 2.5 to 12 watts were considered adequate for most houses. With the advent of the later systems now in use, these powers were recommended to be increased from 3 to 6 db, depending upon the size of the house. It has been found from this investigation that it is both practical and eminently desirable to make a further

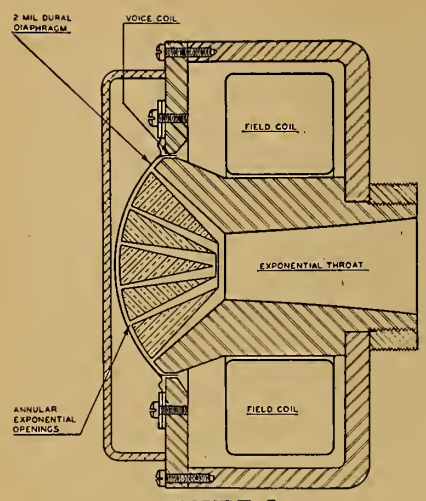


FIGURE 2

Lansing 248E high frequency unit

increase of at least the same amount.

The figure given of one acoustic watt per one thousand square feet of floor area is felt to be the minimum which will do justice to the advanced conception of reproduction with modern recording technique. It is of interest to note that this figure can be achieved, allowing for considerable latitude above this point without danger of mechanical damage to the units.

The advisability of extending the frequency range of a reproducing system must be determined by balancing the gain in naturalness obtained by the extension, against the resulting increase in noise and extraneous sounds. In the present state of the recording art, a characteristic flat to 6000 cycles is the least that will do justice to the film; an extension to 7000 or even 8000 cycles is advisable, and a further extension is not. This is so because a further extension becomes of less and less value, due to the decreasing sensitivity of the ear and the small amount of energy in this region, and especially because above 8000 cycles, noise, flutter and harmonics due to recording deficiencies become decidedly the limiting factor.

Incidentally, since practically all recording systems include a low pass filter with a cut-off in the neighborhood of 8000 cycles, there is nothing on the film at high frequencies to be reproduced.

Once the high frequency limit is chosen, the low frequency limit is automatically fixed. It has been found that for ideal balance the product of the two cut-off frequencies must be fairly close to 400,000, so that for an 8000 cycle upper cut-off, the lower becomes 50 cycles.

High Frequency Horn

One of the principal limitations of present theatre installations is bad directional characteristics. The plain exponential horn has a directivity which varies with frequency: low frequency sound is projected fairly uniformly over a wide angle, but as the frequency is increased this angle decreases rapidly until at frequencies of several thousand cycles practically all of the energy is emitted in a narrow beam. The result of this is that the reproduction becomes very "drummy" or "bassy" for that portion of the audience whose seats lie well off the axis; while the opposite is true for seats located directly on the axis.

In the present system this effect is eliminated by using a radiating system for the high frequency unit which is composed of a cluster of small exponential horns, each having a mouth opening of approximately 60 square inches. These individual units are stacked in layers to form a large horn, the mouth opening of which is spherical in shape. The principle of this high frequency unit can best be likened to a further compacting of the typical cluster of loud speakers, as customarily used in auditoriums and stadiums for public address systems and announcing, except that the whole array is fed from a common header and driven by two dynamic units. This type of high frequency radiation is also a feature of the aforementioned reference system[2]. However, the reference horn having been developed to a very limited angle and being driven by a single mechanism, was not adaptable to theatre use as more than one horn became necessary for full coverage. This would result in non-uniform distribution as well as complete loss of coverage for a large part of the auditorium, should one unit fail during a performance.

One of the features of the reference system is the use of a single diaphragm to reduce phase distortion. Inasmuch as theatres require parallel operation as protection in the case of failure of one unit, experiments were made with a Y throat and two units. As a result of these experiments, it is now recognized by all concerned that any increase in phase distortion which may be introduced by the Y throat is negligible.

The diaphragms are made of duraluminum .002 inches thick and have an area of 6 square inches. The diaphragm is mounted on the back of the assembly, and by the use of an annular opening[2] the sound that is admitted to the throat within the unit has a minimum phase distortion (Fig. 2). This is still further reduced by having this throat exponential beginning at the annular opening and avoids a sharp discontinuity that may exist with a tubular throat. Two units are connected by means of a Y throat to the multi-channel horn which tends to reduce the distortion of high throat pressure. The field excitation requires 25 watts per unit.

The directional characteristics of the resulting unit are very satisfactory as found in theatre installations. It should perhaps be emphasized that lack of good distribution can not be corrected by equalization in the electrical circuits, since for any given adjustment the overall response is a highly varying function of position in the house. Although the characteristic can be made flat for any given position, it can not be made so for all or even a large part of the house by this method.

Low Frequency Horn

In the case of a low frequency unit, a suitable driving mechanism was not available, and it became necessary to develop one. The unit finally adopted consisted essentially of an exponential horn with a mouth area of 50 square feet, and an axial length of 40 inches, driven by four 15-inch dynamic units of special design. The mouth opening was

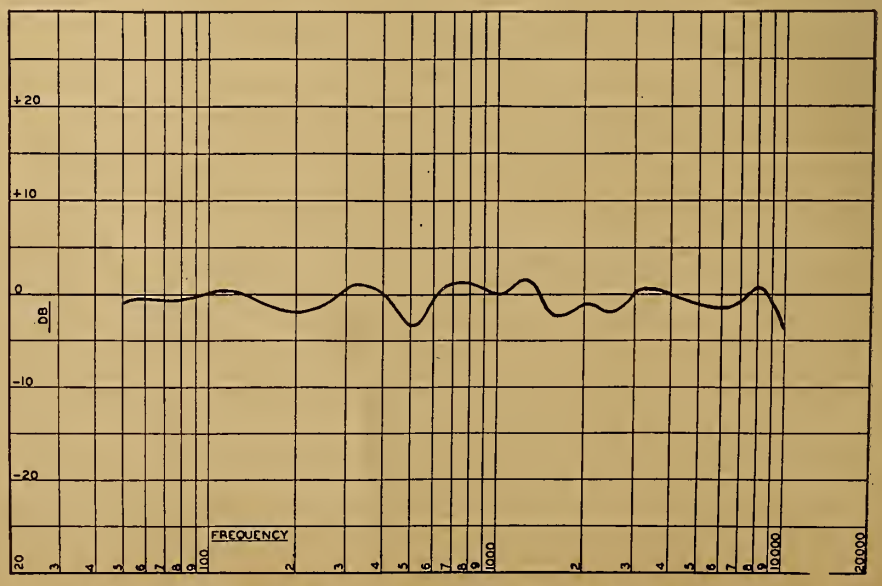


FIGURE 3. ***Output characteristic. Measured on normal axis and 10' from horn***

extended laterally to form a flat baffle 10 ft. x 12 ft.

The paper cones are dipped with lacquer to prevent them from absorbing moisture. which would vary their response. They are connected in series-parallel to give a desirable impedance characteristic, as well as providing insurance against complete failure of the system in the event any individual unit would fail. The angle of distribution is uniform through an arc of 50° on each side of the axis.

The use of a horn instead of a flat baffle board for low frequencies has several advantages. The efficiency is raised from 10 or 15 per cent to better than 50 per cent, which effects an enormous reduction in amplifier capacity. Undesirable radiation from the rear of the unit is considerably reduced and as a result the usual objectionable back stage low frequency "hang-over" is decreased to a negligible amount[1]. For purposes of further compactness and rigidity the low frequency horn may advantageously be folded and in this form retains the same characteristic. if the air path length be maintained unchanged. This modification was contributed by Dr. H. F. Olson of RCA. The loading provided by the air column of the horn decreases the excursion of the diaphragms as compared to the excursion necessary to produce equivalent output from a flat baffle array, and distortion is correspondingly reduced (Fig. 3).

With the low frequency horn length as specified in the design under discussion maintained approximately equivalent to the length of the high frequency horn, there is no time delay between the component sounds from the two horns.

The Horn Assembly

The folded horn is assembled in sections, each section containing two driving mechanisms. They may be stacked one upon the other, depending upon the number required. Each section is adequate for an output from the amplifier of 25-30 watts for the required minimum harmonic content. If it is desired to secure a wide lateral distribution. the sections may be placed side by side.

The entire horn is assembled so that the center of the high frequency unit is approximately 50 to 60 per cent of screen height. This position has been found by years of use to be the center of activity or "presence" on the screen, and since the high frequencies are responsible for determining the "presence," the unit was so arranged. In order to keep the sound as near a point source as possible, the low frequency horn is maintained at a position near the high frequency horn (Fig. 4).

The complete assembly is a unit so that it can be moved away from the screen or raised and lowered with the screen with a minimum effort. The use of sections for the low frequency horn allows the horn to be shipped and moved into spaces which have standard size doors.

For both the low and the high frequency units a certain amount of directivity is desirable. For most houses there should be but little energy radiated at angles greater than about 45° from the axis, since such energy will be reflected from the walls, and since for the best illusion the ratio of direct to reflected sound should be as high as possible.

There is one additional consideration with regard to directivity which should be mentioned. Dr. V. O. Knudsen[4] has shown that at the higher frequencies, *e.g.*, at 10,000 cycles, absorption of the atmosphere may become very serious, being as great as 0.2 db per foot under certain conditions of humidity and temperature. In large and deep houses this would result in a serious loss of high frequencies in the rear seats. This effect can be considerably reduced by increasing the high frequency radiated from those horns of the unit which serve these seats. It may be done by putting a suitable amount of absorbing material in the other horns and re-equalizing to bring the overall response up to standard for the front seats. These artifices will probably not be required in most houses.

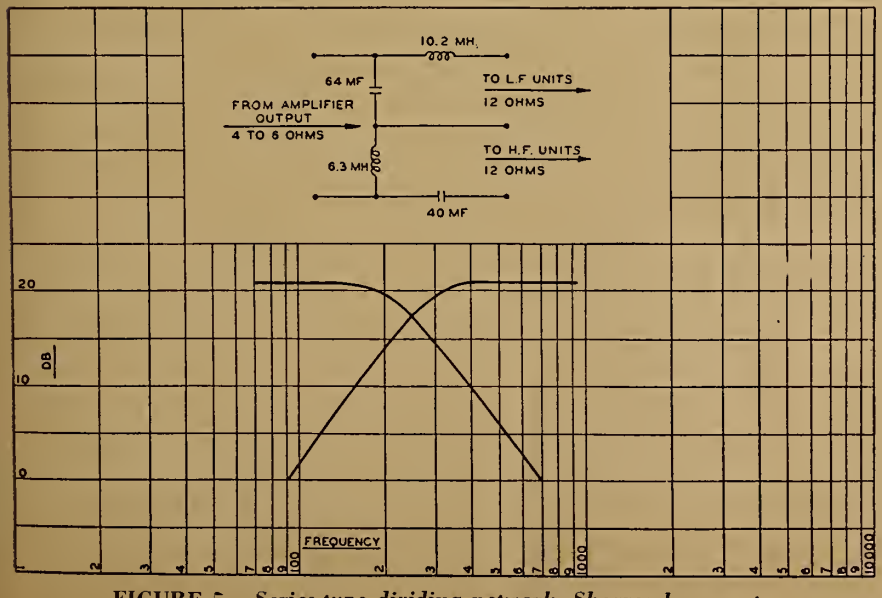


FIGURE 5. *Series-type dividing network, Shearer horn system*



FIGURE 4
The folded horn assembly

ONE major defect of commercial loud speakers is their large amplitude distortion. One of the striking improvements in the new system is its cleanness of reproductions at low frequencies. The measured harmonic content is less than 4 per cent at 40 cycles for 30 watts output. This is due in large part to the use of a thick and comparatively soft cone which can be driven to full excursion without break up, and consequent harmonic production.

It was found by actual listening tests that with a pure tone of 40 cycles impressed, most of the cone speakers investigated gave a greater apparent loudness than the speaker finally adopted. However, when a direct comparison was made by keying the amplifier from the new unit to the unit under test, it was at once obvious that the output of the new one was fairly pure 40-cycle tone, while that of the other speakers consisted of, in most cases entirely, the second and higher harmonics. Direct measurement of the acoustic output showed that in spite of its low apparent loudness, the fairly pure output of 40 cycles was actually about 5 db higher than that of the other speakers.

This great increase in apparent loud-

ness due to transferring part of the fundamental power into harmonics in the conventional speaker is very striking, and is undoubtedly the explanation for the alleged high efficiency of many present day speakers of all types. The loudness of the harmonics is not due to the rapid change in the sensitivity of the ear at low frequencies which would favor the harmonics at the expense of the fundamental, since it also occurs at fairly high frequencies where the sensitivity of the ear is varying in the opposite way with frequency.

With one particular pair of units tested, the effect was more striking at 1000 to 2000 cycles than at any other frequency. It is equally great with complex sounds, such as speech and music, although here the change in quality is somewhat less with respect to the change in apparent loudness than in the case with pure tone.

Another important advantage of the new system is that it can easily be made to fulfill the requirements that the virtual sources of all the components of the reproduced sound shall coincide in the vertical plane. This condition is impossible to obtain with divided frequency range systems now in use in which the axial length of the several types of horns in a given system are widely different. In this respect, a two-unit system is much easier of adjustment than a three-way system[1].

It might be thought that since the time delay is so small (of the order of a few milli-seconds) the effect would be inappreciable. This is true for certain types of sound such as sustained music passages, but on dialog and especially certain types of sound effects which are of the nature of short pulses, a very objectionable distortion is usually noticeable. A striking demonstration of this fact was obtained by recording a tap dance, which when reproduced showed that the system with a very small time delay gave a naturalness of reproduction: but that systems which had an appreciable delay reproduced the scene with far less realism. In fact, the sound did not appear to come from the screen, and, in addition, the tap was fuzzy in character with a decided echo.

This effect sounds somewhat like that of transient distortion due to the use of a filter with too sharp a cut-off, but it is actually more analogous to the echo effect often observed on long lines and with certain types of phase distortion networks.

A recent paper[1] discusses the features of the three-way system including some of the limitations which require special installation technique for the setting of horns, back stage draping, phasing of various horn positions, position of horns

(*Continued on page* 24)



SAMUEL R. BURNS
1882—1936

Samuel R. Burns, 54, president of International Projector Corp. and the secretary and vice-president of General Theatres Equipment, Inc., died on March 5 after a brief illness. A former president of the Nicholas Power Co., Mr. Burns has been associated with the motion picture industry for 20 years.

He was a Fellow of the S. M. P. E., and a member of numerous fraternal and social organizations, including the Seventh Regiment Veterans and Lodge No. 110, F. & A. M.

THE memory of some men defies the best efforts of those who seek to string words together in an effort to recapture, however briefly, the spirit of a fine personality. S. R. Burns was such a man; and the lavish expenditure of phrases is quite futile on this occasion, so at variance is it with his nature.

Many people in many walks of life have cause to remember with affection S. R. Burns. Some for his charity, never outwardly manifest; some for his magnificent fortitude, the true extent of which only he knew through years of suffering; some for his manliness, in the finer sense of the term; some for his keen mentality and splendid ability in everything he undertook (the list grows long and still falls far short) and all for a standard of honor seldom attained by man.

This writer is only one in the rear rank of the army of those whose memories of this man render inept any such effort as this. That which needs to be set down here is one of those simple, commonplace expressions invariably associated with the memory of a splendid personality—an expression that unfailingly is uttered whenever S. R. Burns is mentioned: "He was one of the finest men I ever knew."—J. J. F.

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

U. S. Leads World With Wired Film Theatres, With 15,858

Wired theatres now open in the U. S. total 15,858, according to a recent *Film Daily* survey, which figure is fixed as 775 more than were open during the previous year. Canadian theatres, all wired, are said to number 883.

South America is credited with 5044 houses, of which 3338 are wired. Russia is reported as having 29,691 theatres, of which only 3000 are wired, in a world survey that shows a total of 87,879 movie theatres operating.

Re-examination Urged As Cleanup Move in N. Y.

The N. Y. *World-Telegram* has taken up the cudgels, in its news and editorial columns, in behalf of the proposal made by President Joseph Basson of Local 306 (I. A. unit) that the city's 6000 "operators" be re-examined on the basis of the substantial advances made in the art since the existing license requirements were set. I. P. advocated just this move more than a year ago as the only possible means of bringing the number of projectionists down to at least striking distance of the number of available jobs in N. Y., accurately placed at 2000.

Said Mr. Basson through the medium of an interview in the kindly-disposed newspaper: "A thoroughgoing re-examination is necessary, not only in the interest of safety but in order to settle the labor turmoils that have plagued the industry in N. Y. I myself was licensed on the basis of an oral quiz I took in 1908, when simple electrical questions were asked, such as what to do if a fuse blew.

"This large surplus of operators who pay their $10 licensing fee to the city every year is a constant source of turmoil. Many will never find employment and many are incompetent. Some have never worked in a projection room. Yet they are always a menace to the operators who have always made this their trade."

Mayor F. H. LaGuardia and the License Bureau have expressed approval of the re-examination proposal.

Loew Contract with Erpi Revealed by the SEC

Contract which Loew's, Inc., parent company of M-G-M, has with Erpi, runs for 15 years and calls for a minimum royalty of $100,000 a year, it was revealed recently by the Securities Exchange Commission in connection with a Loew debenture issue. The contract provides for charges of $500 per 1,000-foot reel or fraction thereof of the negative production of features, with a provision that the charge shall apply to all reels in excess of 5,000 feet only if the additional footage exceeds 200. On newsreels a charge of $100 per 1,000 feet is provided. The charge is to apply whether all or part is made with sound. On master records made independent of specified pictures a charge of $500 for each 10 minutes of playing time is made.

Contract also provides that Loew cannot make sound records for radio, although it may broadcast sound from pictures which it makes.

Independent Dealers Gather at Chicago, June 5 to 8

Advance reports on Independent Theatre Supply Dealers Association's Sixth Annual Convention at the Edgewater Beach Hotel, Chicago, June 5 to 8, indicate that it will be one of the most successful undertakings in the history of the organization.

"Independent conventions have proven so successful in the past," said J. E. Robin, executive secretary, "that they have become annual events. Manufacturers have an opportunity to display and discuss their merchandise, while dealers receive first-hand information on the latest and newest theatrical equipment and supplies. This year, actual working exhibits will be on display for dealers to study and discuss over. A record attendance of manufacturers and 100% member-dealer representation is being arranged for."

A. T. & T. 'Virtual Monopoly', F.C.C. Probe Develops

Federal Communications probe into affairs of A. T. & T. and subsidiaries, including Western Electric and Erpi, got under way in Washington. President Gifford of communications setup admitted that his company is a "virtual monopoly" in phone field. Disclosed that A. T. & T. controls 168 corporations in many fields. Gifford said that A. T. & T. came into possession of two film studios through non-payment of debts. Sound picture operations of phone outfit expected to be covered thoroughly.

Writer Rejects Academy Screen Play Award

Dudley Nichols, crack screen writer, extended the battle lines of the Screen Writers' Guild against the Academy when he declined the latter's award for best screen play of 1935 ("The Informer"). Excerpts from Nichols' rebuff:

"As one of the founders of the Screen Writers' Guild, which was conceived in revolt against the Academy and born out of disappointment with the way it functioned against employed talent in any emergency, I deeply regret I am unable to accept the award. To accept it would be to turn my back on nearly 1,000 members of the Guild, to desert those fellow writers who ventured everything in the long drawn out fight for a genuine writers' organization, to go back on the convictions honestly arrived at, and to invalidate three years work in the Guild which I would like to look back on with self-respect.

"I realize the awards were voted by a generous membership who had no thought of personal partiality or political intent. But a writer who accepts an Academy award tacitly supports the Academy, and I believe it to be the duty of every screen writer to stand with his own and strengthen the Guild, because there is no other representative autonomous organization for writers which aims at justice for employer and employee alike and which is concerned solely with the betterment of the writing craft."

Writers' Guild has been reported as seeking close tie with I. A. T. S. E.

Eastman Kodak Registers Wide Gains in 1935

Consolidated net profit of $15,913,251, after taxes and reserves, and equal to $6.90 per share on the outstanding common stock, was reported by Eastman Kodak for the year ended Dec. 28, last. The company earned $14,503,247, or $6.28 a share, the previous year. In a letter to stockholders, F. W. Lovejoy, president, said: "The volume of business continued to increase during 1935, sales showing an increase of 8.5 over 1934 and 24 per cent over 1933."

Long-Term Motiograph Sales Deal With Joe Hornstein

Joe Hornstein, Inc., prominent metropolitan New York area supply dealer, has concluded a long-term distributorship arrangement for the Motiograph projector and sound system. First installations are now going in, reports Hornstein, with more to come. Territory involved on an exclusive basis embraces southern New York, eastern Connecticut and northern New Jersey.

Sound Completes Conquest of Picture Studios

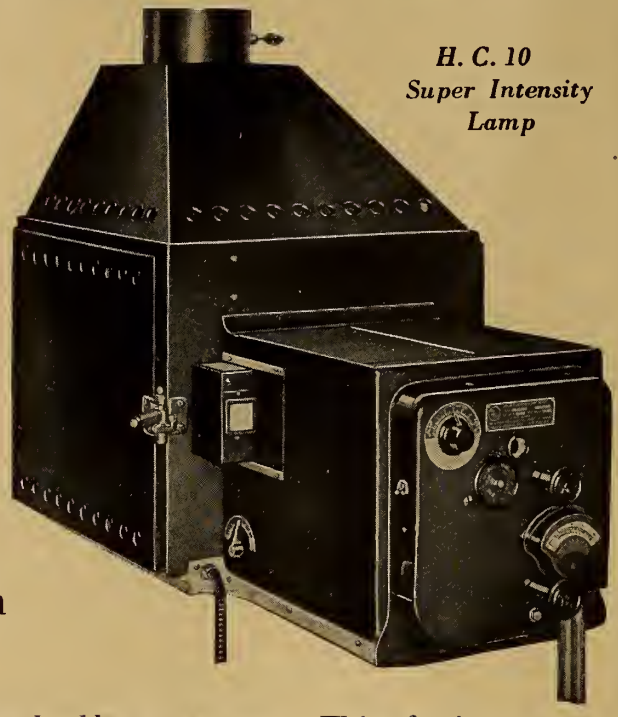
Silent scenes in films are no more, reports Carl Dreher, head of Radio Pictures studio. Radio's consumption of sound stock rose in 1935 to 7,000,000 feet, after remaining at 5,000,000 for three years. Last year nine pictures used over 200,000 feet of sound each.

The total footage run through the recorders since Radio began making sound films, according to Dreher, was more than 32,000,000 at the end of 1935. More than one-third, or 37 per cent, of all features released by Radio in 1935 contained music, with an increase expected this year.

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DEVELOPMENT OF SHEARER TWO-WAY HORN SYSTEM

(*Continued from page* 22)

for distribution and setting of volume between horns. Familiarity with this data will assist in appreciating the principles of the present system.

The Dividing Network

The frequency chosen for the critical frequency of the dividing network is governed by several factors. If this frequency is too low, it leads to uneconomically large values of capacity in the network, and to impracticably large horns for the high frequency unit. If too high, there is danger of running into the characteristic dip which seems to be always present in large cones, and also, it would result in dividing the prime energy of speech sounds between the two units, which is objectionable from the standpoint of good presence. If the critical frequency is chosen as approximately 250 cycles, a good compromise results (Fig. 5):

A dividing network was chosen which gave fairly rapid attenuation, 12 db per octave, in order to keep any appreciable low frequency energy out of the high frequency unit, and to minimize the effect of irregularities encountered in the response-curve above the designed range of the low frequency cones. This lies somewhat above 400 cycles for an efficient low frequency unit. Certain dividing networks in current use have attenuation curves of such gradual slope that at some frequencies the irregularities in the response curves of the speakers are actually greater than the attenuations of the network.

The network is designed so that the reflected impedance of the horn on the amplifier is approximately 2.5 times the amplifier impedance. The loss in the

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network is less than 1 db in order that the full capacity of the amplifier may be utilized.

Measurement Results

While it is recognized that indoor response measurements do not have the degree of precision that may be had in free space, they nevertheless do represent conditions under which the speakers must actually be used for motion pictures. Also, for the purpose at hand, comparative measurements are sufficient and were verified by listening tests, which is the final criterion. (Fig. 3 shows average response).

Irregularities in the sound pressure at the microphone due to standing wave patterns in the room are minimized by the use of a conventional warble frequency, varying plus and minus 25 cycles at a 10-cycle rate. Tests have been run which indicate that the warble is only effective below 2000 cycles. Above this point, the standing waves do not interfere with the correct interpretation of the response curve.

The measurements were taken in a stage 100 ft. x 70 ft. x 35 ft., having a reverberation time of one second at 512 cycles per second. By making these measurements indoors, tests could be made rapidly on a large number of units, without the interference from outside noises due to a 60 db insulation between inside and outside provided by the building.

The response curves were measured using a high speed level indicator[5] capable of responding to a change in level as rapid as 300 db per second.

Douglas Shearer, head of the M-G-M Sound Department, brought about and directed this project. This development was engineered by the writer and contributed by M-G-M Studios. The cooperation of the following companies is gratefully acknowledged: Epri, RCA,

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THE USE OF INJUNCTIONS IN LABOR DISPUTES

Henry W. Lehmann

U. S. Bureau of Labor Statistics

AN INJUNCTION is an order issued by a court to restrain certain persons from conduct which, if not stopped, may result in irreparable property damage. If applied to workers or labor organizations, the court order is known as a labor injunction. In the United States both Federal and State courts have the power to issue injunctions in labor disputes.

Federal courts have played an important part in molding the law with regard to labor injunctions. Their power rests largely upon their right to prevent conduct which, if unrestrained, would interfere with the transportation of the mail or would disrupt commerce between the States. The Sherman anti-trust law, which prohibits combinations in restraint of trade or commerce among the several States, is the Federal statute which has been used most often as a basis for issuing injunctions. The Supreme Court held that this statute included within its meaning labor as well as business combinations.

The rulings of the several courts relating to labor controversies have not been uniform. This is due largely to the fact that the courts of the 48 states and those of the Federal Government all have independent power to issue injunctions. Conduct which in one State might be restrained is often declared legal in other States.

Injunctions in Strikes

To what extent does the injunction limit collective activity of workers, such as the strike and the picket line? What standards do the courts use in determining the kind of conduct by workers to be enjoined? The legality of collective action depends chiefly upon its purpose or intent. Moreover, even if the purpose of collective action is declared legal, it cannot be achieved by the use of illegal means, such as fraud or violence.

Thus, in the case of a strike, if the purpose is a proper one, such as to raise wages, no injunction can prevent the strike. But if violence, intimidation, or other means considered by the court to be illegal are employed in the conduct of the strike, the legitimate nature of the purpose will not save the strike from being enjoined.

It is generally agreed that strikes to secure higher wages, shorter hours, or better working conditions are strikes for proper purposes. But there is no agreement as to the legality of the strike undertaken to secure a closed-shop contract or to force a dismissal of non-union workers. In some cases, however, courts have sufficiently approved of collective agreements between employers and employees to declare as illegal strikes or lockouts which constituted a breach of such an agreement.

Injunctions in Picketing

Picketing—that is, the patrolling by strikers of the place of employment for the purpose of persuading workers not

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to take their jobs—is generally regarded by workers as an effective tool in the conduct of the strike. As in the case of strikes, the legality of picketing may depend on its purpose. Purposes which justify a strike will also justify picketing. Thus, picketing in a strike for higher wages is usually considered legal.

The lawfulness of picketing also depends upon the *character of the conduct* in each particular case. Great differences of opinion exist among the State and Federal courts as to what conduct is permissihle on picket lines. Violencc, the use of force, fraud, and intimidation are prohibited everywhere. Some courts have held that all picketing necessarily involves intimidation and hence must be restrained. But a preponderance of judicial opinion concedes the possibility of peaceful picketing and merely restricts violence, the use of deception in persuading other men not to work, and other forms of clearly illegal behavior.

Does the use of language such as "scab" constitute intimidation, or may the picketing be considered peaceful despite utterances of this kind? Judicial interpretations as to the legality of such conduct differ. Some courts find in this language sufficient intimidation to warrant the issuance of an injunction. Other courts demand more compelling evidence of violence and intimidation before they will restrain workers from picketing.

How many men may picket? The Supreme Court has not established a hard and fast rule in regard to methods of picketing. Each case must be handled on its own circumstances. Generally, in the absence of violence, the courts tend to permit more pickets than in the cases where a record of violence and mutual ill-will exists. In recent times injunctions have frequently specified the *exact number* of men permitted at each entrance to the picketed plant, the number of paces they must be separated from each other, and even the character of the language they may be permitted to use.

Other activities of workers in their relations to employers have been restrained by the use of the injunction. Thus, a union may be enjoined from persuading employees to strike in violation of individual contracts with the employer wherein the workers have promised not to strike. Such individual contracts are commonly known as "yellow-dog" contracts.

Legislation on Injunctions

At first, the courts only protected contracts which existed for a fixed term, but later it was held that an injunction could be used to prevent the union from inducing employees to strike where the contract of employment was terminable at will. Thus, if employees promised that while they held their jobs they would not strike, any attempt to persuade them to strike would be enjoined by some courts regardless of whether the contract of employment was for an indefinite or a fixed period of time.

Legislation by Federal and State bodies has considerably modified the law dealing with the use of injunctions in labor disputes. The Clayton Act passed in 1914 declared that "the labor of a human being is not a commodity or article of commerce" and that "nothing contained in the anti-trust laws shall be construed to forbid the existence and operation of labor organizations . . ." It provided that an injunction shall not prevent the quitting of work, the lawful advising and persuading of others to quit work, and the peaceful assembly of workers. Injunctions may be issued only when necessary to prevent irreparable damage to property.

Another important provision of this act established, under certain conditions, the right of jury trial in contempt cases arising from labor disputes. Several states passed similar laws. In interpreting these laws the courts held that they did not legalize violent action in strikes or the use of force. One law which a State court interpreted to permit mass picketing and intimidation was held unconstitutional by the Supreme Court of the United States.

The Norris-LaGuardia Act

Congress made no further changes in the existing injunction law until 1932, when it passed the Norris-LaGuardia Anti-Injunction Act. This statute lays down conditions which must be fulfilled before a Federal court may enjoin the collective conduct of workers. The act specifically declares that every worker shall "have full freedom of association, self-organization, and designation of representatives of his own choosing . . ." In accordance with this law individual agreements by workers not to belong to a union or not to join strikes, etc., which have often been used as a basis for issuing injunctions, may no longer be protected in any Federal court in the land.

The Norris-LaGuardia Act also lists certain types of conduct against which no injunction may be issued. Employees are permitted to give publicity to the facts involved in a labor dispute by patrolling, advertising, or any other method not involving fraud or violence.

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They may also assemble peacefully to further their interests in connection with a labor dispute. Moreover, no injunction may be issued to prevent the payment of strike benefits.

There still exist, however, cases where the Federal courts have jurisdiction to restrain collective action by workers. Such, for example, is the case of an industrial dispute in which fraud or violence is involved. But certain limitations restrict the court's power to issue injunctions even in these cases. Before a Federal court can act it must find: (1) that unlawful acts have been threatened and will be committed unless restrained; (2) that substantial and irreparable damage to employer's property will follow; (3) that greater injury will be inflicted upon him by the denial of relief through an injunction than upon the worker by the granting of the injunction; (4) that the employer has no adequate remedy at law; and (5) that the local police are unable or unwilling to furnish adequate protection. Moreover, no injunction may be issued unless the defendant is given notice and an opportunity to be heard. This restricts the previous practice of issuing injunctions upon the statements of one party only.

Federal courts may still issue what is known as a *temporary* restraining order if it is shown on testimony under oath that irreparable damage will result to the employer's property by the denial of such relief. Such an order expires after five days. To obtain it the employer must put up a bond as security for any loss that might result to the worker from such an order erroneously issued.

The Norris-LaGuardia Act applies to the *Federal courts only*. However, the legislatures of approximately 12 States have passed similar statutes to regulate the power of their courts with respect to labor injunctions. Among these states are Colorado, Idaho, Indiana, Maryland, Minnesota, New York, North Dakota, Oregon, Utah and Washington.

Although the Supreme Court of the United States has not reviewed the constitutionality of the Norris-LaGuardia Act, its action in a recent case indicates that it is not inclined to view the provisions of the act as repugnant to the Constitution. The case in question came up to a Circuit Court of Appeals, which held the act valid. On appeal to the Supreme Court that tribunal refused to hear the case, thus letting the decision of the circuit court stand.

See Early Erpi Shift to RCA Variable-Area Method

Reliable sources credit Erpi as being "on the verge" of flopping over from the variable-density system of sound film recording now used to the variable-area method introduced and popularized by RCA. As usual, it was impossible to confirm this report through Erpi. The latter is understood to have been playing with the idea of utilizing the Miller mechanical method of recording (stylus),

but is thought that this idea has been abandoned.

Erpi is privileged to use the RCA system by virtue of the free interchange of patent rights which was one of the outcomes of the constant decree entered in the government anti-trust suit against the electrics in Wilmington several years ago. The commercial implications of any such move by Erpi are obvious, entailing the necessity of a complete about-face by Erpi in its attitude toward sound-film recording systems. Since the introduction of sound Erpi has persistently proclaimed the advantages of the variable-density method. For Erpi to now advise its licensees that the variable-area method long used by RCA is considered the better would put Erpi squarely on the well-known spot commercially and undoubtedly occasion a not inconsiderable loss of prestige.

Recent important advances in sound-film recording by RCA lend credence to the aforementioned report.

WIDE-RANGE REPRODUCTION REQUISITES IN THEATRES

(Continued from page 11)

either set of units be reversed, a new series of positions are found for the baffle half-way between the points lying upon the previously mentioned series. It is no wonder, therefore, that this effect was mistaken at first for vector phasing.

In the early technic, speakers were set to reproduce correctly for a point on the floor of the house, and the balcony was regarded as of secondary importance. However, in several installations where two observers were available, one was placed in the balcony and one on the floor of the house. It was surprising to find that both these observers chose the same phasing positions in spite of the fact that in some cases the observer in the balcony should have been in a position 180 degrees out of phase with the position of the observer on the floor. In other words, this effect is not a real sound-vector phasing effect, but appears to have something to do with the diffraction pattern set up about the top edge of the baffle and the bottom edge of the horn. This is further corroborated by the fact that the so-called phasing position is independent of the vertical distance between the lower edge of the horn mouth and the top edge of the baffle.

The backstage acoustic difficulties are brought about mainly by the radiation from the back of the low-frequency units and by the mid-range sound reflected into the backstage area by the screen. This sound is reflected from the various walls of the backstage area, and some of it returns to the units in such phase relation as to add to the sound then being radiated. Under these conditions marked standing-wave patterns are set up. The commonest, and usually the most marked, of these patterns is that existing between the low-frequency units and the rear stage wall. In order to minimize this pattern the baffle is usually inclined slightly with respect to the vertical in such a manner that the sound returning from the back wall and striking the baffle is reflected slightly upward, thereby avoiding a sharp standing-wave pattern between two hard, parallel surfaces. In spite of this precaution, a rather severe pattern is usually set up, and acoustic absorption material is necessary to counteract its bad effects.

In order to diagnose the position of this velocity maximum it is necessary only to move the head slowly from the back wall to the baffle while the system is reproducing male speech. During this procedure the positions are noted at which the so-called "boominess" of the sound is least. These positions of least "boominess" are the points at which damping material will be most effective. From a commercial standpoint is it fortunate that the minimum nearest the baffle is usually the sharpest one, and, therefore, constitutes the most effective position for the draping material.

The draping material used is unimportant, provided that it is soft and flexible and has an absorption equivalent to Ozite, ¼ to ½ inch thick. Two thicknesses of heavy velour spaced one inch apart have been found quite satisfactory.

Having found the proper position for

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the drape, which is usually called the main drape, it is hung immediately. It is now necessary again to explore the backstage for additional standing-wave patterns which sometimes arise between the low-frequency units and the sidewalls or between the low-frequency units and the ceiling.

With the main drapes in place, it is occasionally found that the sound as heard in the auditorium, either lacks "presence," that is, appears to come from some distance behind the screen, or that it seems as if considerable non-linear distortion were present. Under these circumstances it is necessary to explore the backstage area, particularly the region between the bottom of the horn mouths and the top of the baffle, for the presence of patterns. This is done, as in the previous case, by moving the head slowly about in this area while speech is being reproduced. In this case, instead of getting sharp maxima and minima of intensity, a condition is found in which the head moves from a region of badly garbled speech to one of relatively clean, clear, intelligible speech. As before, drapes should be hung at the position of least garbling; in other words, at the position of maximal clarity.

The importance of careful backstage draping can not be too vigorously stressed because most of the troubles of the early installations of wide-range systems were brought about by complicated backstage patterns. These troubles were mainly removed when this pattern was properly diagnosed and the necessary drapes hung.

The High-Frequency Units

It will be seen that up to this point the system has been operated without the high-frequency units, and that it is ready for commercial use except for the addition of these units. It has been found by experience that the positioning technic for these is similar to that for the baffle with respect to the mid-range units. The positioning of the high-frequency units is of great importance as regards the quality that will be obtained from the system. The high-frequency units show a definite series of fore and aft positions, with respect to the mouth of the mid-range horns, at which the sound quality is pleasing.

If the polarity of the high-frequency units be reversed, a new series of positions are found lying half-way between the positions of the first series. This is a rather startling result, because the air path difference to the screen from the diaphragm of the mid-range units and from the diaphragm of the high-frequency units is frequently as great as fourteen feet. This distance corresponds roughly to forty times the distance between the positions at which the high-frequency units sound good. Since the dividing network is not of the sharp cut-off variety, there is considerable overlap between the mid-range and high-frequency units and it is readily seen that this positioning effect cannot possibly be real vector phasing.

Having positioned the high-frequency units by ear during the reproduction of an adequate test-film, the only remaining step is to regulate their intensities so that they blend properly with the rest of the reproduction. With this done, a final check is made with the commercial product available in the theatre.

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Reproducing equipment designed and installed to fulfill the foregoing requirements has been in use in more than twelve hundred theatres. In some theatres it has been in operation for more than two years. Practically all types of auditoriums are represented. Under these circumstances the problem of attaining and maintaining optimal performance through installation and service of the equipment has been of much importance.

The equipment as developed and installed, has proven itself very flexible under these varied practical conditions of field operation. It has been possible to use the system in houses of widely varying acoustic properties and to achieve in these houses the full dramatic possibilities of which the equipment is capable. This, of course, does not mean that all the houses have been found satisfactory without the help of acoustic treatment. On the other hand, it does mean that many houses, which, on the basis of the old system, were regarded as very difficult acoustically, have been successfully equipped with the wide-range system with no acoustic treatment of the auditorium.

Although the average releases do not include material that completely shows the capabilities of wide-range systems, there are some that do, and a steady improvement in this respect is rapidly becoming general. As this is written, releases are being shown that can not be presented to full advantage on restricted-range systems.

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WHEN St. Luke—Chapter 18, Verse 25—was trying for a metaphor denoting the extremely difficult, he wrote: "For it is easier for a camel to pass through the eye of a needle," etc. That probably referred not to a sewing needle but was a picturesque designation of the narrow slitted, one-man side gates of the walled cities of Syria.

However, the putting of the camel through the needle's eye is no considerable undertaking as compared to the performance of the motion picture projector which puts maybe a billion and a half dollars' worth of entertainment in the United States each year through an aperture about the size of a postage stamp.

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Projectionists have become so competent, machines so perfect in function, that we often tend to forget about projection. But after all it is not, in all of its perfection, automatic. High standards of projection are to be maintained only by unrelenting vigilance, constant, unwavering attention to that needle's eye of the industry. Ten thousandths of an inch, hundredths of a second, matter vastly at the needle's eye, and again out on the screen. In a considerable number of theatres, still, despite all of the facilities available, projection is yet to be brought up to the best attainable standards.

A great deal has been set down about refinements and enhancements of sound recording in "wide range" and "high fidelity" and much has been said about the necessity for bringing sound reproduction channels up to capacity to deliver all that the sound track carries. Meanwhile refinements of the camera, lenses and photographic emulsions, studio lighting and actinic values have also given to today's negatives and prints a new range of values in tone and quality that can be delivered to the audience only by the best of equipment and projectionist skill.



Editor Motion Picture Herald

This editorial indicates the interdependence of the various departments of the Motion Picture Industry and is a recognition of the necessity for technical coordination in this field. It is reprinted from the Motion Picture Herald by permission and published by the manufacturers of

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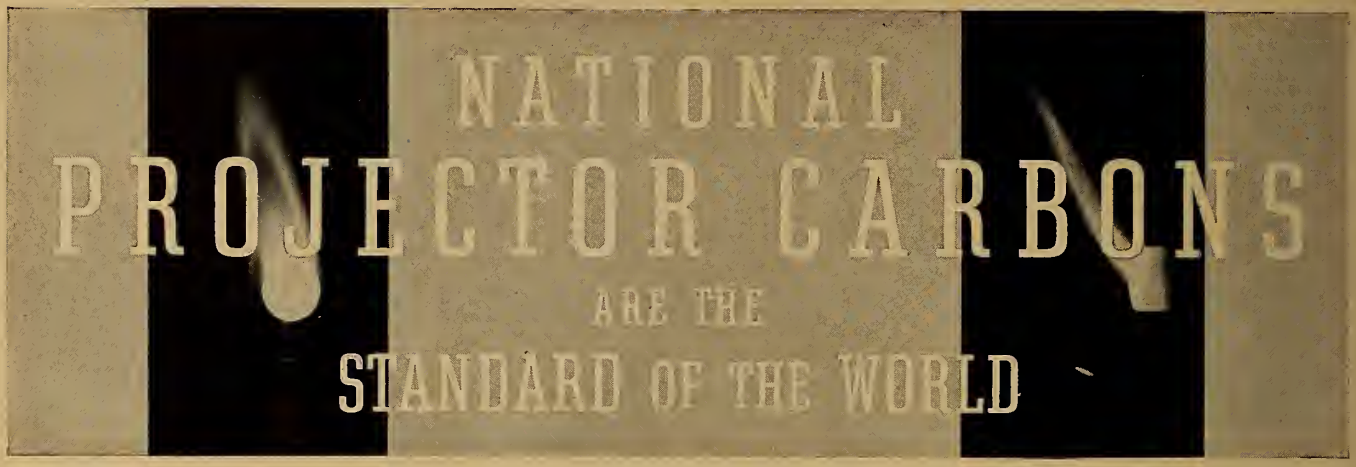
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Arc Current Amperes	Approx. Arc Volts	Polarity	SIZE and KIND	
			National Cored Projector	National Solid Projector
10-15	54-57	Positive	9 mm x 8″	.....
		Negative	.....	6.4 mm x 8″
16-20	54-57	Positive	10 mm x 8″	.....
		Negative	.....	7 mm x 8″
21-25	54-57	Positive	12 mm x 8″	.....
		Negative	8 mm x 8″ or	8 mm x 8″
26-30	54-57	Positive	13 mm x 8″	.....
		Negative	9 mm x 8″	.....
31-35	54-57	Positive	14 mm x 8″	.....
		Negative	10 mm x 8″	.....
			National SRA Cored Projector	
28-32	54-57	Positive	12 mm x 8″	
		Negative	8 mm x 8″	
32-42	54-57	Positive	13 mm x 8″	
		Negative	8 mm x 8″	



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International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

Volume 10 MAY 1936 *Number 5*

Index and Monthly Chat 5

Observations Anent Current Topics 7
JAMES J. FINN

Recording, Lighting Advances Feature S.M.P.E. Meeting .. 11

Function and Application of Sound System Analyzers, IV.. 12
A. C. SCHROEDER

Great Cost, Technical Problems Bar Television Splurge, Says Academy 14

International Alliance 33rd Convention in Kansas City, June 8 15

Final Revision of Long Reel Standard for Aug. 1 Bow ... 16

A Review of Screen and Theatre Illumination Data 17
A. A. COOK
S. K. WOLF

News of the Month 22

News Notes

Technical Hints

Miscellaneous Items

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MONTHLY CHAT

LONG the bugaboo of approved projection room layout, adequate ventilation facilities is the hinge upon which turns a possible reduction in projectionists' insurance rates. Insurance company representatives admit that rooms in general have been improved considerably in the past ten years, and that more safeguards have been thrown around the person of the "man behind the gun". However, they still condemn ventilating facilities in more than 80 per cent of theatre projection rooms.

Here's a legislative proposition that is worth any amount of effort and should be what flaming American youth terms a "pushover".

WHICH reminds us that from now to late September is the time for projectionists to get a goodly portion of carbon dust and other such miscellany out of their lungs. Walk in the sunlight and open air (not ride) as often as possible.

PROPONENTS of color feature pictures aver that the greatly increased number of such releases during the 1936-1937 season will enable "approximation" of black-and-white costs. One just must applaud this evident determination to succeed; but we still can detect a difference in costs of 3 cents a foot in favor of black-and-white.

Now arises from the mist the pertinent question of where this difference will come from. Certainly not from the theatres showing a double-feature program for 15 cents.

THERE is no cessation in the flow of "ideas" for automatic projection. Some contributors modestly confine their efforts to the change-over process; while others contrive to work out allegedly perfect (and invariably "foolproof") automatic controls for screen light, arc gap, change-over of both sound and picture, and focus. Threading the projector and rewinding is a mere detail to be worked out almost immediately.

DATA bearing on screen brightness appearing in this issue testifies to the many ramifications of this vitally important topic. This is valuable information for every projectionist.

TO THE more than 800 delegates to the forthcoming I. A. Convention in Kansas City—good luck. This time the fellers from the studios can walk in feeling that they really belong. Stagehands should sing a few hosannahs for the Federal Theatre project.

SUPREX lamp manufacturers, noting the determination of projectionists to follow through on that magnification ratio item, have agreed to reform. The Projection Committee of the S. M. P. E. has agreed to see that the agreement is kept. I.P. is agreeable to checking up on everybody concerned.

Great South-Eastern Theater Circuit Adopts BRENKERT as Standard Equipment

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April 29, 1936

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INTERNATIONAL PROJECTIONIST

VOLUME X NUMBER 5

MAY 1936

Observations Anent . . . Some Current Topics

By JAMES J. FINN

TELEVISION, a topic which has engaged the close attention of I. P. for several years now, has been subjected to the investigational facilities of the Academy of M. P. Arts & Sciences, a technical committee of which has just reported its findings, published in detail elsewhere herein. Briefly stated, the Academy finds that the industry is "psychologically prepared" for television (as it was not for sound pictures); that the art will have no large-scale development before 1938; that television, when, as and if it arrives, will cost staggering sums of money, difficult to absorb on a commercial basis comparable with radio broadcasting, and that the motion picture theatre likely will endure for many years to come (it hopes).

There is no intent to detract from the job done by the Academy on this subject; yet its report is practically a limited rehash of the conclusions advanced by Dr. A. N. Goldsmith in his paper, "Television and the Motion Picture Theatre," published in I. P. for May, 1935. In fact, the only discernible difference between the Goldsmith opus and the Academy report is the inclusion in the former of more factual data bearing on the technical and commercial obstacles now confronting this new art.

Noteworthy among the Goldsmith predictions was that which stated: "People are interested in change (from the home) . . . also, people are gregarious and somehow seem to have their emotional responses enhanced by crowd enthusiasm . . ."—an opinion with which there will be little disagreement. Overall, there is a bit too much soothing syrup in the Academy report: for example, it fails to indicate what means may be employed by the motion picture industry in staving off the inroads of a new form of entertainment. Dr. Goldsmith was afflicted by no such myopia; he stated bluntly that the future of motion pictures lie in the hands of its leaders, a forward-looking attitude on the part of whom was absolutely essential if television was to be made a partner rather than a competitor of the motion picture. The industry is susceptible to many improvements—starting with Hollywood, home of the Academy—a majority of which concern the theatre itself. Motion picture merchandising is beset with many frills and turns: too much high-pressure being exerted in distributing the picture from studio to theatre, and too little common sense being applied to merchandising the industry's wares to the public.

Well-informed opinion holds that the situation created by the imminence of television requires the services of a coordinator who, thoroughly familiar with the technical and commercial aspects of both motion pictures and radio broadcasting, could guide and advise the picture industry so that its natural advantages as the best medium of entertainment for the masses might be preserved. This is no Hays office or Academy job.

• •

MONDAY, May 25, marked the passing of an era in the history of the development of sound pictures. On that day RCA signed Columbia Pictures Corp. to a recording license, marking the first serious break in the wall which Erpi had thrown around major producers (excepting Radio, of course). RCA channels will be ready for use by

Columbia on Sept. 1 next. Deals with other major producers are pending.

RCA recently reduced its rates to approximately $600 a reel for a world-wide license of an original language recording, estimated to be from $150 to $300 less expensive than the Erpi figure. Erpi recording licenses with major companies run to about 1944, and call for a minimum annual payment of $100,000. Naturally, all the majors have far exceeded this minimum every year to date. Columbia likely will record on Erpi channels up to this minimum figure, and then use RCA recording for the balance of its program. It is reported that several other major companies have calculated that they can charge off the Erpi minimum figure and, using RCA recording channels, still save money.

But the reduced RCA license rates are only half the story. Red hot several months ago was the story of the threatened RCA suit against Erpi on the basis of restrictive contracts, for both recording and reproducing licenses (emphasis upon the former). The story suddenly petered out, with a conscious effort by both RCA and Erpi not to revive it. Obviously a settlement had been agreed upon.

I. P. told the story at the time. It retells it here. Briefly, reliable sources credit RCA with every intention of launching a $30,000,000 damage suit against Erpi. RCA's twin objectives, it seemed, were to open up the field of recording licenses and to relegate A. T. & T., parent body of Erpi, to the field of communications—thus laying the groundwork for *exclusive* RCA participation in the other electronic arts, including television! I. P. has always believed that the latter was the primary concern of RCA. Anyhow, informed quarters saw in the projected RCA suit sufficient excuse for much hedging and trimming by not a few prominent industry personalities—connected not with either of the sound companies but with well-known exhibiting firms! The implication was obvious.

The whole affair suddenly blew over. A. T. & T. was concerned primarily with the nickel-in-the-slot communications business—telephones! However lucrative was its Erpi subsidiary, nothing was to be allowed to interfere with the parent body's primary interest—telephones! I. P. published reports that Erpi was offered to Atlas Corp., prominent New York financiers, who already owned half of both Paramount and RKO. This deal, very much alive for several weeks, finally fell through. Erpi apparently was on its own.

Arises now the question of how RCA, in the face of existing Erpi contracts running to 1944 to which is appended a minimum royalty payment of $100,000 annually, can sally forth and sign up one or more or all of the major producers?

Here again the question itself suggests a rational answer: settlement of the RCA-Erpi difficulties on the basis of opening the door to RCA recording licenses. Royalty of $600 per reel on each feature certainly oughtweighs any profit that might accrue from the sale and servicing of theatre equipments.

What is Erpi's future in the motion picture field? Nobody can accurately answer this question at the moment; although the appended abstract from a letter received recently by I. P. might reasonably be expected to color one's views on the subject:

"You will be interested to know that Erpi has closed the . . . . . office. Without advance warning they moved out the furniture, and now retain only . . . men in the entire district. Figure out for yourself the morale of what's left. Naturally, I.P. can claim a large part of the credit for this occurrence . . . "

To which need be added only a solemn yet emphatic "Amen." Plus a reminder that someone, somewhere once said that the influence of the projectionist craft was negligible.

• •

FROM New Orleans comes a letter excerpts from which provide an opportunity for large-scale advice to the craft on a topic which has engendered widespread interest of late. Quoting:

"I am operating and *servicing* RCA equipment. I have tried on numerous occasions to obtain a circuit diagram, having requested the local service man and also having written twice to the factory. The reply to my first letter was evasive; my second letter has not been answered.

"I.P.'s stand is that the projectionist should be afforded all possible assistance in the way of diagrams, etc. . . . I feel that you should include RCA in your campaign against sound equipment manufacturers who do not give necessary information. I feel that you are sincere in your fight for the craft, and that this letter will start something."

H. G. Graham
New Orleans, La.

It did start something. Inquiry revealed that hundreds of letters are received weekly from projectionists requiring information anent every unit of theatre sound systems, plus requests for detailed statements relative to the electronic art in general. Not a few of these requests come from theatres which, having dispensed with manufacturer's service, require factory assistance to unravel some particularly difficult problem. Such a theatre, not being a revenue-producer in the form of service fee income, naturally is not accorded the full facilities of the factory. Thus is intruded into the discussion I. P.'s oft-expressed opinion that competency is the first consideration in any individual or group servicing.

Service notes are prepared for each new RCA theatre equipment sent into the field. Lost, strayed or stolen—one knows not what happens to these notes, the original quantity of which is predicated upon the number of units turned out. Replacement of these notes in their original form constitutes quite an expense item. A detail of competent technical men to answer the hundreds of service inquiries which reach RCA each week is also quite an expense item, which ultimately must be reflected in upward revision of the basic service charge. Thus the RCA stand.

What's the answer to situations such as that described by the aforementioned correspondent—an answer that is at once fair to both RCA and the customer who in the interim may have dispensed with RCA service? A plan looking toward a solution of this problem satisfactory both to the manufacturer and the purchaser is now being drafted jointly by I. P. and RCA. Announcement of this plan, entailing a not inconsiderable amount of work, will be forthcoming within the next two months. Until then —stand by.

• •

FAMILY troubles are best settled around the family council table. This has ever been the traditional policy of the American Labor movement—whether for better or worse remains to be seen. Jurisdictional rights, two words long employed as a sweet, high-sounding phrase, have thinned out considerably since 1930, due to the strain imposed by other and more practical considerations. It requires considerable courage for I. P., with an almost exclusive projectionist clientele, to suggest that maybe the foregoing few words are peculiarly applicable to much-talked-about but seldom-acted-upon projectionist and stagehand difficulties.

• •

TESTS of various types of mirrors—metal and otherwise—indicate that there has not yet been found a non-pitting reflective surface for use with carbon arcs. True, a metal mirror offers stiffer resistance to carbon pits, in addition to having certain other obvious advantages over the glass reflectors. However, it has been impossible to date to attain any degree of uniformity in the production of metal mirrors, even with two mirrors put through at the same time. The results have been widely differing characteristics as to curvature and in other respects.

Another serious disadvantage of metal mirrors is their extremely high cost, running to three times the cost of glass. This, coupled with the apparent impossibility of attaining uniformity, apart from the fact that they eventually will pit anyhow, constitutes an almost insurmountable barrier against any general use of metal mirrors.

MAY 11, 1936—Fourth Anniversary of *High Fidelity*

For four years RCA High Fidelity Sound Equipment has been building box office for theater owners. No date in the entire history of sound motion pictures is of greater importance to you—to pictures themselves—than May 11, 1932, which marks the birth of the most natural, realistic reproduction the theater has ever heard—RCA Photophone High Fidelity Sound.

Amazing sound—made possible with vastly superior equipment, which records and reproduces fundamental tones and practically all overtones as well. These overtones make the different instruments and voices easily distinguishable to your audiences, giving astounding naturalness. Such is the result of improving and coordinating every unit through which sound passes in its course from studio to screen.

This tremendous sound advance is of vital importance to the movies. Not only is perfect tone reproduced, but volume in the theater duplicates volume of the original recording. The loudest tones give no distortion, and background interference has been so reduced that the softest tones are beautifully clear.

Such perfection makes all pictures more lifelike, more thrilling to your audiences—and means greater box office than ever before for users of RCA Photophone High Fidelity Equipment.

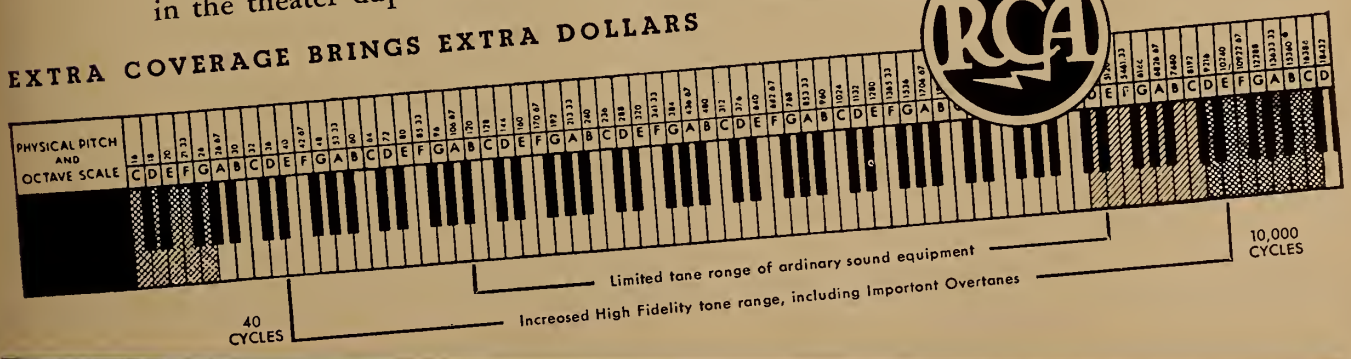
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EASTMAN *SUPER X*

PANCHROMATIC NEGATIVE

RECORDING, LIGHTING ADVANCES FEATURE S. M. P. E. MEETING

Sharp Gains Scored by 16 mm. Sound Equipment; Further Recording Refinements; Carbon Arc 'Hard' Lighting Wins Studio Favor; Projection Equipment Standards Sought; Membership Gains

MARKED by a diversified papers program ranging from slide films to three-dimensional movies in color, the Spring Meeting of the Society of Motion Pictures Engineers, held in Chicago the week of April 27, offered filling fare to technicians in all branches of the motion picture industry. The one disappointment was the absence of Douglas Shearer of the M-G-M studio, who, with the cooperation of RCA, was scheduled to deliver a paper on and demonstrate an improved system of sound recording and reproduction. An elaborate reproducing system had been installed by RCA for the occasion, thus the assembled engineers were offered the very best sound reproduction throughout the sessions.

Widespread interest in Society activities was reflected in the report by E. R. Geib, chairman of the Membership Committee. Refinement in sound recording and reproducing equipments, particularly the latter, was noted in the Progress Report. Outstanding technical advances during 1935 included the new Kodachrome color film, the effective silencing of cameras which extended the use of "hard" carbon arc lighting on sets, and the extension of the three-color Technicolor process to features. RCA's ultra-violet method was assayed the major advance in sound recording.

Ambitious Projection Program

A demonstration of X-ray talking pictures, showing the complex movements of the internal speech organs, was probably the most interesting paper of the sessions. "Photoelectric Cells and Their Method of Operation" was an exposition of the photoelectric phenomena. Various operating features of p.e. cells were demonstrated. W. C. Kalb, of the National Carbon Co., offered evidence in support of the opinion that the present trend is toward a more extensive use of high-intensity carbon arc light sources. This trend is pronounced in the studios, which of late have exhibited a marked preference for carbon arc lighting. The Screen Brightness Committee charted its course to date and cited its aims, a partial presentation of which is contained elsewhere in this issue.

The Projection Practice Committee reported that it was embarking upon its most ambitious program to date—the establishment of standards for the installation and operation of visual and sound projection equipment. Citing the multiplicity of such national, state and local laws, often in sharp conflict with one another, the Committee announced its intention of pressing the adoption of standards which, it is hoped, will win the approval of national regulatory bodies and, possibly, be accepted as an American standard. The present chaotic situation with respect to conflicting laws, the Committee holds, operates "to defeat the best efforts of manufacturers, exhibitors and projectionists to attain better results; and also permits the widespread use of decidedly inferior equipment and encourages sub-standard installation and operating practices."

Other activities in which the Committee is currently engaged include the further refinement of projection room layouts for small, medium and large theatres; general auditorium lighting; determination of the correct mirror magnification ratio for Suprex arcs; illumination and sound transmission characteristics of screens; types of screen masking; suitable starting acceleration for motors driving projectors (avoidance of excessive strain and consequent damage to equipment and film), and projection illumination of color film.

Future recommendations by the Committee will state specifically whether they apply to black-and-white or color film. Attention will also be given to obtaining a suitable light meter for distribution to theatres at a reasonable cost. Several sample meters are now being considered.

A new line of Weston meters for both black-and-white and color film was described and demonstrated by A. T. Williams under the title, "Theory and Use of Photoelectric Exposure Meters." The source construction and color of light of some incandescent lamps was discussed by R. E. Farnham of the G. E. Nela Park plant.

The new 13.6 mm. super high-intensity carbon, for operation on currents as high as 190 amperes, was described by D. B. Joy, of National Carbon Co., who asserted that an increase of 30 per cent in screen light over the 125-ampere, 13.6 carbon was obtained. (An abstract of this paper is appended hereto.) The safe handling and storing of film was the topic of a presentation at Underwriters' Laboratories, Chicago. Urging compliance with the regulations of the National Board of Fire Underwriters, a description was given of recent tests which established the low ignition point of motion picture film.

Copper-Oxide Rectifiers

Copper-oxide rectifiers for motion picture arcs were treated in detail by representatives of Westinghouse and of General Electric. This presentation, when originally scheduled, promised to touch off an interesting discussion between proponents of rectifiers and of generators, but only a few relatively unimportant comments were forthcoming. Data bearing on the construction, efficiency and economy of these rectifiers was presented, together with curves tending to show slow aging and an almost unlimited life at high efficiency.

Advantages of the optical, non-intermittent projector with a single lens wheel (as contrasted with the old-style double lens wheel) were set forth by A. J. Holman in the paper, "Projectors and Projection" (abstract appended). It was pointed out that although projection is the ultimate and all-important process of the industry, little interest is manifested in the art by producers, directors and exhibitors. Mr. Holman severely criticized the principle of intermittent illumination, and asserted that the optical projector delivered vastly superior results, particularly for color. Admitting the absence to date

(*Continued on page* 25)

S. M. P. E. Test Reel Used Throughout the World

The standard test reels distributed by the S.M.P.E. are doing much to improve the quality of sound reproduction and motion picture projection, according to a Society announcement. These two films known as "The SMPE Standard Sound and Visual Test Reels" already have had distribution in 21 countries. Theatres in the United States have purchased 167 prints of the sound reel and 52 prints of the visual reel. Holland leads among foreign countries with 38 sound and 15 visual reels.

These films which are used as a standard of sound and projection were produced under the direction of the Projection Practice Committee in cooperation with RCA, for the purpose of providing the industry with a precision tool for checking sound and projection.

Function and Application of Sound System Analyzer Equipment

By A. C. SCHROEDER

MEMBER I. A. LOCAL UNION 150, LOS ANGELES, CALIF.

IV

MOST analyzers are built so that they may be applied as an ohmmeter, which is used not only to measure the resistance of resistors, chokes and transformers, but also for finding leakage in condensers and for checking circuit continuity. The circuits are arranged so that the same meter is used in the ohmmeter and in the analyzer proper. A source of voltage, usually a battery, a fixed resistor and a variable resistor complete the circuit.

Figure 10 is the circuit for one range of resistance measurement. Usually two or more ranges are available, and different resistors and batteries are provided for the various ranges.

For the discussion of the circuit we will again assume that the meter is a 1-mil. instrument: when the needle is at the right of the scale a current of 1 mil. is flowing. To produce this condition the circuit components must have a total resistance so that the battery voltage divided by this resistance equals .001 (1 mil. equals .001 amp). If a 1.5-volt flashlight cell is used, this resistance must be 1500 ohms. The meter will account for about 50 ohms, and the battery for about 20 ohms. The resistance to be measured is connected to the binding posts at X, and for the present X is shorted, so there is zero ohms here.

So far we have accounted for 70 ohms, leaving 1430 that are required in R and V jointly. V is a variable resistor used to correct the circuit when the voltage of the battery has dropped somewhat. When a new battery is installed it will be necessary to adjust V so that all the resistance is included in the circuit; in fact, this should be done before the battery is changed, or at least before it is used to make any measurements with the fresh battery installed.

With all of the variable resistor in the circuit, and with X "shorted", the meter will read somewhat less than full scale. V is now adjusted so that the needle goes to the extreme right end of the scale, and this will be marked zero on the ohmmeter scale (there being zero resistance across X). Note that this ohmmeter scale has the zero at the right end, and the numbers increase toward the left; while the scales for current and voltage have the zero at the left, and the numbers increase toward the right.

Battery Aging a Factor

As the battery ages, the needle will no longer go to the zero position when X is "shorted." To correct this, V is reduced a trifle, until the needle rests at the zero mark. This should be checked every time the ohmmeter is used. As the battery nears the end of its useful life its voltage drops rapidly, and one cannot be certain that the zero setting will remain correct very long. It is best to renew the battery when this stage is reached.

When a resistance is connected across X, the meter will read more (on the ohmmeter scale) than it did with X shorted. This is because the ohmmeter scale is reversed with respect to the other scales. The needle will not go as far to the right as it did, indicating that less current is flowing, caused by an increase in the resistance of the circuit, and the meter scale is graduated to indicate this increase in resistance.

By connecting 1500 ohms across X, the total resistance becomes 3000 ohms (1500 ohms in the ohmmeter and 1500 ohms across X), and only half as much current will flow. By applying Ohms Law, 1.5 divided by 3000, we get .0005, or .5 mil. The needle only goes half way across the scale, and we find a graduation marked 1500, indicating 1500 ohms resistance at X. The calculation is not necessary when using the ohmmeter, but is done here to make clear *how* the result is obtained.

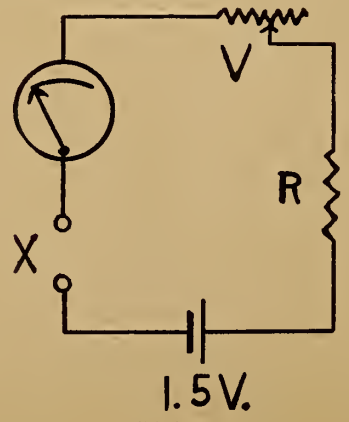


FIGURE 10

If a 45,000-ohm resistor is placed across X, we have a total resistance of 46,500 ohms, allowing .032 (about 1/30) mil. to flow, so the needle only goes 1/30 of the way across the scale. which is quite close to the end. This end represents infinite resistance, and we see that there is only a small part of the scale left to indicate all resistance from 45,000 ohms to infinity. If we wished to measure a leak of 1 megohm, we could not do so with any degree of accuracy.

Provision has been made for this, however. If we place a 45-volt battery in the circuit, and replace R by a resistor of 45,000 ohms (actually it would be somewhat less, since R and V together with the meter and the battery would total 45,000 ohms) we will get a reading of 1 mil. when X is shorted. Again connecting the 45,000 ohms at X, we find that the needle now goes half way across the scale, and at this position. under the 1500-ohm mark we found previously, we find that 45,000 has been placed. In other words, we have been describing another range of the ohmmeter.

In this higher range we have one-half of the scale to measure resistances from 45,000 ohms to infinity; where on the lower range we had only 1/30 of the scale for this same range of resistances. On this scale the 1-megohm graduation will be from 1/20 to 1/25 of the way across the scale, thus allowing us to read a resistor of 1,000,000 ohms with greater accuracy than we could read the 45,000-ohm resistor on the lower range.

Percentage of Error

When speaking of accuracy, bear in mind that this is only relative. On parts of the ohmmeter scale there may be an accuracy better than 10%, that is, the *error* will be *less* than 10%. On other parts of the scale the error will be more than 10%. Much of this depends upon the care and ability of the person using the device. One might wonder whether an instrument with so large an error is of any use, but let me assure you that it is very useful indeed, as will be brought out later.

The difficulty experienced in reading

very high values of resistances is duplicated in reading relatively low resistances. Assume that we have a resistor of 50 ohms. This will give an indication very close to the zero mark on the range using the 1.5-volt battery, the low range. The 50-ohm mark will be about 1/30 of the way across the scale from the zero end. We have 1/30 of the entire scale to read resistances from zero to 50 ohms.

Let us arrange the circuit so that it looks like Fig. 11. Of course, this is not the practical circuit: a switch is needed, otherwise the current would flow continuously. Other switches will also be present, because this circuit will be a part of both the low and the high range circuits of Fig. 10, to say nothing of the other circuits of the analyzer, as described in previous installments. In Fig. 11 the components have the same values as in the low range in Fig. 10, thus there will be a current of 1 mil. in Fig. 11, when X is *open*.

When a resistance is connected across X, some of the 1 mil. that had been going through the meter, will be shunted around it, thus reducing the meter reading, the needle assuming a new position. It is true that the current in the circuit will increase slightly when this is done, but the difference is too small to effect greatly the result.

Notice that in Fig. 11 the needle is at the right when X is open, and in Fig. 10 the needle is at the left when X is open. When X is shorted, the needle is at the opposite end in both cases. In Fig. 10 the needle is at the right when there is zero resistance ("shorted") at X. As the resistance is increased the needle leaves the zero position, moving to the left. In Fig. 11, when there is zero resistance at X, all of the current is flowing across X, none of it goes through the meter, the needle remains at the left and consequently this is the zero position for this scale. This shows that the scales for the two circuits will be reversed with respect to each other.

We know that when equal resistances are connected across the same voltage, the currents through the resistors will also be equal. If we connect a resistor of 50 ohms across X in Fig. 11, we place it in parallel with another 50-ohm resistance, the meter. Thus, two equal resistances are connected to the same voltage, and the current through them will be equal. Since the circuit allows 1 mil. to flow, if this is divided so that it goes through two paths, there will be .5 mil. in each path, the meter will show a reading of half scale, where the graduation will be marked 50, indicating 50 ohms.

Actually, this introduces an error of about 1.8%, since the current increases to 1.018 mils when the 50-ohm resistor is hooked across X, the total resistance of the circuit having been reduced to 1475

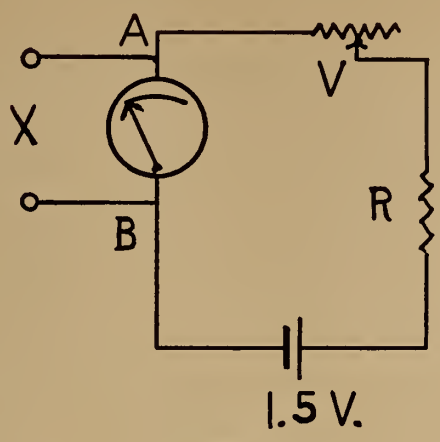


FIGURE 11

ohms. With X open, there is 50 ohms from A to B, the meter resistance. When we connect another 50 ohms across X, the resistance from A to B is reduced to 25 ohms, reducing the total resistance of the ohmmeter to the same degree. This is a small error, but in the commercial instrument even this is corrected in the design of the apparatus and in the calibration.

With this circuit we have half of the scale to measure resistors from 0 to 50 ohms; while with the circuit of Fig. 10 we have only 1/30 of the scale. The advantage of Fig. 11 is that the scale is more open and can be read more easily.

Applications of Meter

Now that we have discussed the circuits of the ohmmeter at some length, let us see how we can use them. Probably the first and most useful function of this portion of the analyzer is the testing of circuit continuity. Test leads are fastened to the binding posts at X, while the other ends of the leads have prods. When the prods are placed at the two ends of a wire the meter will read zero, unless the wire is one of very great length or made of resistance material.

The purpose of this test is usually to ascertain whether a certain wire is continuous when that wire cannot be seen throughout its entire length. It may run from one end of the amplifier to the other, in a more or less devious path, probably in a cable with a number of other wires. Of course, they may be color coded, and it would be possible in some cases to trace it visually, but this would require more time than would a test with a meter. The wire may be broken inside the insulation, and it would be impracticable to determine this without some sort of test.

Before using the ohmmeter, make sure that the circuit to be tested is dead. No voltage must be present except that in the ohmmeter. In the aforementioned test it is best to use the scale for the lowest range of resistances. If only the continuity of the circuit is to be determined, it makes no difference which scale is used; but if the aim is to determine whether the wire or connection has practically zero resistance, then it is necessary to use the lowest range. There are amplifiers where a resistance of one ohm in the wrong place will ruin the stability.

Condensers are readily tested with the ohmmeter, but it requires some thought and a knowledge of condenser characteristics. One of the limitations is that some condensers will test O. K. on voltages that we have in the ohmmeter but will "short" on the high voltages in an amplifier. This is not always so, but we must keep it in mind, as it is a possibility that may turn up when least expected.

Condenser Characteristics

The average paper or mica condenser, if it is O. K., will produce no "permanent" indication of the meter; it has practically infinite resistance. Usually there will be a slight jump of the needle, but this is only the charging current; after the condenser is charged, which is almost instantaneously, the needle should return to zero.

Electrolytic condensers must be connected to the ohmmeter so that the positive test lead goes to the positive condenser terminal. This type of condenser is rather hard to test, as there is a comparatively high leakage current whenever a voltage is applied to the terminals. In the event that the condenser is hooked up in the wrong direction, a comparatively low resistance will be indicated, and the condenser may be ruined this way.

As these condensers are self-healing, a short circuit is "repaired", so to speak, automatically, and the only use of the test will be to show that the internal circuit to the electrodes is complete. In the case of the paper or mica type this is indicated by the slight jump of the needle when first connected. Electrolytics also cause the needle to jump when first connected, but the needle does not return all the way to zero thereafter.

We come now to the testing of coils and transformers. It was mentioned previously that a large error is encountered in the use of the ohmmeter, and we shall see how it is that such a condition may be tolerated.

Suppose that we are going to measure the resistance of the primary winding in an interstage audio transformer, and we find that it has 2000 ohms. We do not know what the resistance should be, but we do know *about* what its value should be. We know that it must be more than 100 ohms, probably more than 1000 ohms. It is not likely that it will be greater than 10,000 ohms, and very likely much less than this figure. So we have established some values that will limit the "resistance range" of this type of winding. If we should get an indication of 500,000 ohms we know there is something wrong, probably a corroded connection within the device. If the reading were a few hundred ohms, we know that there is a partial

"short" or that the condition is due to a grounded winding.

This so-called "resistance range" can be narrowed down some more when we classify the different types of interstage transformers. Different tubes require different impedances into which they should work, and the transformer will conform to this requirement. As our knowledge of tubes and transformers increases, our personal "resistance range" for the different types becomes narrower and more definite. One soon becomes familiar with the average resistances of choke coils, etc. These devices have a lower resistance, as a rule, than do audio transformers (unless the chokes are of the type used for impedance coupling) with the exception of certain low-impedance transformers.

Transformers used for filament and plate supply are still another type. For filament supply, the secondary will run around a few ohms, and sometimes only a fraction of an ohm. The secondary of plate transformers may be a few hundred ohms. Do not confuse impedance and resistance. The impedance may be ten times the value of the d. c. resistance. It also depends upon the frequency at which the impedance is measured. For audio work these usually are 400 or 1000 cycles and at such frequencies the impedance is very much greater than the resistance.

When measuring certain types of resistors we can come quite close to knowing what the value should be, as is the case with bias resistors. If we measure a bias resistor and find that it is 1000 ohms, we can easily find what the value should be; and if the two correspond, it is O. K. If the resistance should be 300 ohms we know that it must be replaced. These values are often given in tube tables, or they can be found by ohms law, knowing what the bias voltage should be and the current that will flow through the resistor. Voltage-dropping resistors and voltage dividers run higher, and it is harder to know what the exact value should be, but a study of the circuit will lead one with a fair knowledge of amplifiers to ascertain without much trouble the approximate value.

As with everything else, practice makes perfect. It does not take long for one with some experience in sound to become quite handy with the ohmmeter, and for that matter, with the entire analyzer. In this series of articles the writer has tried to show the underlying principles and the reasons for the various functions and circuits of the analyzer. If these are studied and put into practice, the analyzer will become a very useful tool.

Great Cost, Technical Problems Bar Television Splurge, Says Academy

A Report of Special Television Committee of Academy

THE present position of sound motion pictures, confronted by the developing art of television, differs fundamentally from the situation of silent pictures before the advent of sound. Viewed in the perspective of ten years, it is clear that before the premiere of "Don Juan" and the accompanying sound picture program at the Warner Theatre in New York City on August 6, 1926, all the elements favoring the transition from silent to sound pictures were presented.

Broadcasting had already attained a formidable place in the entertainment world, demonstrating that reproduced sound was acceptable to the public. The electric phonograph had reached a high degree of development. Public address systems had been used in the last Liberty Loan drive during the war, at President Harding's inauguration in 1921, and subsequently in national political campaigns and other events calling for the distribution of sound to large audiences. Electrical interlocks had been applied in industry, and were available for the synchronization of scene and sound. The technological obstacles had been overcome.

Yet all but a few people in the picture business were skeptical. On the technical side, those who remembered the earlier abortive attempts to link sound with pictures, ignored the recent advances in sound reproduction, although the evidences were before them. Once the technical feasibility of sound pictures had been proved, they were sure that the public did not want them. Even after the notable commercial success of early sound picture productions, this belief survived for some years.

Silent-Sound Switch Costly

As a result of such excessive skepticism within the industry, the transition from silent to sound pictures was hurried, disorderly, and costly. There is no likelihood of a repetition of such a crisis when television becomes a commercial factor. Instead of disbelief, we have, in the case of television, excessive credulity. Both picture people and the public have been waiting for television for five years.

Besides psychological preparedness, the preventive factors keeping television from coming unexpectedly upon our industry are the great technical and commercial complexity of the new medium, and the existence in the picture business of technically-trained personnel capable of following the progress of television and giving notice of impending developments.

Television has reached a point in its laboratory development where a small picture (about 6 by 8 inches) with moderate entertainment value, can be transmitted, but with far more complicated equipment than motion picture recording and sound broadcasting require. The cost of development up to this point may be measured in millions of dollars. Before there is any possibility of nation-wide exploitation, hundreds of millions of dollars must be expended for numerous transmitting stations of limited range, connecting cables of new design, and receivers. None of these things can be obtained overnight. There is a possibility of such a development starting in 1937, or more probably in 1938. It should be noted that its scope, as far as can be previewed, is limited to home entertainment purposes in urban areas.

Barring revolutionary inventions, there is as yet no promise of the enlargement of the field of television to theatre screen size nor of an extension of the possible service area to rural districts in this country.

In the United States a start is being made in reducing television to practice in the field. A new transmitting station is being installed in the tower of the Empire State Building for an experimental service in the City of New York, to begin this fall. About 150 receivers will be furnished to selected observers. These receivers are being manufactured at a cost of probably several thousand dollars apiece, and even upon a quantity production basis it is difficult to see how the cost could be reduced below $300.00.

A new type of cable, suitable for the transmission of television images, is being installed for tests and possible subsequent commercial use between Philadelphia and New York City. Similar developments are in progress in England, Germany, France and other countries. In 1937, therefore, considerable data should be available on points which are now obscure.

This Committee has been making a study of the technical progress of television during the past year, and possesses a general knowledge of the principal systems under development. A bibliography of the available literature and is being kept up-to-date.

No action by the Research Council of the Academy appears to be called for during the balance of 1936. There appears to be no danger that television will burst unexpectedly on an unprepared motion picture industry.

International Alliance 33rd Convention in Kansas City, June 8

MORE than 850 delegates from every territory in the U. S. and Canada (not forgetting the Canal Zone), in addition to several hundred guests, will converge upon Kansas City, Mo., for the 33rd biennial convention of the International Alliance of Theatre State Employees and Moving Picture Machine Operators. Both precedent and I. A. law specify the first week in June for the convention, but deferment of the meeting until June 8 was prompted by the sharp reduction in railroad tariff rates which becomes effective on June 1.

Detailed instructions relating to those sections of the country affected by the cut in traffic rates have been issued by the General Office, the new standard rates supplanting the old special convention rate of one and one-third fare throughout most of the East.

Convention headquarters will be located in the Muehlebach Hotel, while all sessions, including district meetings, will be held in the new Municipal Auditorium, considered the finest convention building in the country. This auditorium, in addition to providing marvelous facilities for every convention need, is air-conditioned throughout, thus insuring the comfort of the delegates during the proceedings. The auditorium seats 13,000, far exceeding I. A. requirements.

Morale at High Point

Kansas City will witness a new *esprit de corps* within I. A. ranks as a result of the widespread gains registered by the organization within the past two years. It is an open secret that the last I. A. assembly in Louisville reflected an all-time low in organization morale, easily the worst in Alliance history. I. A. representation in the West Coast studios was more a remembrance than a fact, with daily defections from the ranks of studio local unions making a shambles of the Coast group. The I. B. E. W. held full sway over the studios by virtue of an alleged exclusive contract with the producers; while the A. S. C., ostensibly a technical society, issued glib statements anent its "five-year contracts" for cameramen and assistants.

Nor were the theatre field connections of the I. A. any too strong. The NRA was crumbling through lack of effective compliance, with theatreowners, aware of I. A. weakness in the studios, exhibiting a willingness to adopt the most high-handed methods in beating the I. A. to the ground. Stagehands were in an extremely precarious position. Dual organizations were flourishing.

The events of the past two years will enable the assembly at Kansas City of representatives of a wholly different Alliance, particularly with respect to organization morale. Undoubtedly the greatest single contribution to what approximates a rebirth of the International was the sweeping victory scored by the I. A. in the West Coast studios. The reinstatement of thousands of I. A. men in studio posts, the reentry of the Alliance into the Basic Studio Agreement on a basis which makes it the dominant craft in the studios, served to strengthen the I. A. immeasurably, not only in the studios but also in the theatre field. Theatre owners awakened to the fact that they no longer could take extreme liberties with theatre workers without reprisals following swiftly.

Vastly Improved Status

Today the NRA no longer exists, a contingency to which practically all labor leaders looked forward with grave foreboding. Yet, unemployment has subsided to some degree, and contract-time last September saw scores of I. A. locals win substantial increases in wages and improvement in conditions. The legitimate stage has revived to some extent, and stagehands in the larger cities have benefitted through the reemployment efforts of the Federal Theatre Project. Dual organizations are by no means definitely on the wane, but their effect has been minimized considerably by the stiff opposition put forth by I. A. units throughout this country and Canada. Progressive simplification of theatre equipments has operated to block any increase in manpower, however bright the future may look as a result of various technical developments which probably will require additional equipment of a more complicated nature. Projection locals, however, have done well with non-theatrical activities, due in large part to the expansion of 16 mm. film advertising activities.

Particularly noteworthy is the almost complete absence of the intensive pre-convention electioneering which has always been a corollary of I. A. assemblies. This fact in itself is indicative of a more cohesive spirit within the organization. The usual preliminary rumblings about replacements in the various offices have been conspicuously lacking.

The opening session of the convention will be called to order at 10 a.m. on Monday, June 8. It is likely that the sessions, including the balloting for and installation of officers, will extend through the following Friday. The standard I. A. convention routine with respect to committee activities and reports, and the time limitation applying to resolutions, will be adhered to. District meetings will get under way on Friday, the 5th, the last being held on the 7th, the day preceding the convention. A schedule of such meetings follows:

June 5—Districts 1 and 11.

June 6—Districts 4, 6, 7, and 12.

June 7—Districts 2, 3, 5, 8, 9, 10 and 14.

Consideration of the proposed revision of the Constitution and By-Laws of the Alliance will constitute one of the major

Official Sound-Men Jurisdiction Agreement

SETTLEMENT of the jurisdictional differences between the I. A. and the I. B. E. W. relative to the sound men in the West Coast Studios, originally scheduled for arbitration, was settled personally between presidents George Browne of the I. A. and Dan Tracy of the I. B. E. W. A verbatim copy of the agreement signed is appended hereto.

Amendment To The 1926 Agreement Between L. U. No. 37, I. A. T. S. E. And L. U. No. 40, I. B. E. W.

Insert the following new paragraph under I. A. T. S. E. division of work:

"In the taking and recording of sound motion pictures, the operating of all sound equipment and all sound effects, and the setting up and striking of same on stages and locations."

Insert the following new paragraph under I. B. E. W. division of work:

"In the taking and recording of sound motion pictures, the operating of all generators and storage batteries. The installation, construction, maintenance, repair, all shop work and all work other than operating, striking and setting of all sound equipment and effects used in taking and recording of sound motion pictures on stages and locations."

tasks of the convention. Changes in the instrument will have the attention of a special committee, representative of the country as a whole, which will meet in Kansas City on June 4. No indication as to the nature of the proposed changes has been forthcoming.

No delegate from a local union which is in arrears to the International for the quarter ending July 31 will be seated by the convention. The General Executive Board will be in session during the week prior to the convention to transact routine business and to receive and pass upon special references.

This, the 33rd convention of the I. A. will mark the organization's 44th birthday. The first general meeting attracted only 16 delegates, with only 9 voting for president. Membership of the Alliance today is conservatively estimated as slightly less than 28,000.

FINAL REVISION OF LONG REEL STANDARD FOR AUG. 1 BOW

MARKING the final revisions in the specifications for the 2000-foot reel standard which will go into industry-wide use on August 1, the Academy Research Council has issued specifications for a 14½-inch reel with a 4-inch hub for the use of all the companies in purchasing reels to meet the new standard.

The 2000-foot reel originally suggested by the Research Council had an outside diameter of 15 inches and a hub diameter of 5 inches, which dimensions were reduced after study of the results of a survey made by a committee representing the eastern distributing companies. This survey, made through the Hays organization and the Film Boards in key cities, indicated that a considerable number of projection machines throughout the country would operate more satisfactorily with a reel of the reduced 14½-inch diameter; and the reel was subsequently redesigned to conform with the findings of this survey.

This change in specifications is believed to have resulted from the protests of several hundred small theatres, mostly in the West. which still are using the old Powers machines in which a 15-inch reel would have been a snug fit. Outstanding projection men favored the adoption of the larger reel, holding that the Powers equipment is now so old that replacement is desirable in the interests of good projection results. Evidently, the double-reel sponsors decided to favor this small group of theatres in order to forestall any difficulty in nationwide introduction of the standard.

Union Attitude on Reel

Still unanswered is the question relating to the attitude of those Local Unions in large cities which have disapproved the larger reel. The I. A. General Office recorded its official disapproval of the larger reel in a recent issue of the Official Bulletin, which advised all affiliated locals to resist the introduction of the new standard. The evident determination of the distributors to proceed with the project indicates that the opposition to the double reel is not sufficiently widespread to occasion serious concern. Whatever the attitude of I. A. locals generally, certain large-city units—certainly Boston and very likely Cleveland and Chicago—continue to manifest unrelenting opposition to the larger reel. Distributors have given no indication as to how they will reconcile these differences of opinion.

Universal, which withheld its approval of the larger reel until recently, has now signified its intention of going along with the rest of the major distributors, thus removing the last serious obstacle to a united front on the part of the producers.

Revised Specifications

Revised specifications are now being distributed to all reel manufacturers, and it is expected that the companies will place orders for the new standard 2000-foot reels during the next few weeks in order to meet the August 1 change-over date. Specifications for the new reel, as finally revised and approved by all participating distributors, are appended hereto, accompanied by a schematic drawing of reel dimensions:

These specifications describe the construction of the release reel to provide suitable mounting, during shipment and projection, for 2,000 feet of standard 35 mm. motion picture film. The attached drawing shall be considered a part of these specifications.

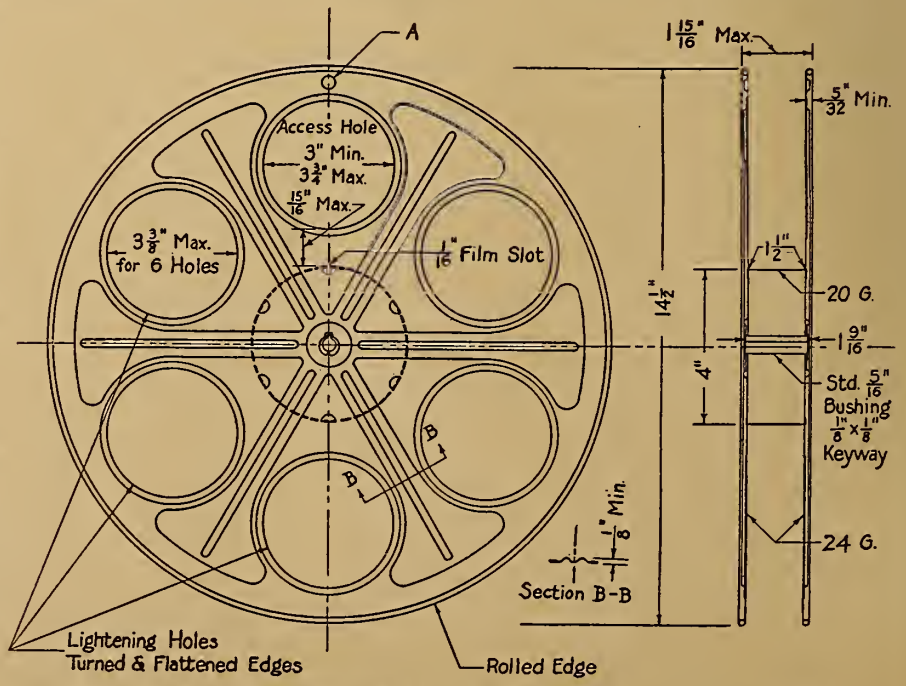
The reel shall have an outside diameter of 14½ inches, a hub diameter of 4 inches, and an inside clear width of 1½ inches. The center bushing shall be of such size as to provide an easy fit on all standard 5/16 inch diameter rewind and projection machine spindles, and shall have a ⅛ by ⅛ inch keyway.

The reel shall be constructed of No. 24 USS gage [.025"] (except the hub which shall be constructed of No. 20 USS gage [.0375"]) with rib heights and rolled edges of dimensions as shown on the drawing, except that thinner gages and slightly greater rib heights may be used for economy of construction, provided such design makes up into a reel of equivalent stiffness in the flanges to the one of specified dimensions. A thin gage which might permit denting of the ribs during use but which at the same time would maintain the essential working dimensions of the reel, would be acceptable.

An access hole for threading shall be provided in each flange adjacent to the film slot, having a minimum diameter of 3 inches, and located as shown on the drawing. The number, size and position of lightening holes in flanges is not specified other than that they must be of such number and position to provide an acceptable running balance.

The reel shall be entirely free from raw edges on all portions which come in contact with film or the hands. The edges of all hand openings shall be turned and flattened and the outer edge of flanges shall be rolled. Flanges shall have an embossed spot near the periphery, opposite the opening adjacent to the threading slot, as

(*Continued on page* 24)



Specifications for new standard reel as finally revised for introduction generally throughout the industry on Aug. 1 next

A Review of Screen and Theatre Illumination Data

During the past twenty years much information on projection screen and theatre auditorium illumination has been accumulated. The appended abridged articles consititute excerpts from the contributions by several members of the Projection Screen Brightness Committee to the illumination symposium sponsored by the S.M.P.E.* This symposium uncovered a wealth of data relating to approved procedure, the most interesting of which to projectionists is presented here.

1. Projector and Screen Characteristics, and Their Effects Upon Screen Brightness

By A. A. COOK
BAUSCH & LOMB OPTICAL CO.

THE first portion of this study of available screen brightness will be devoted to the motion picture projector; and particularly, to the optical parts of the projector. These optical elements vary considerably in size, shape, and position in the various types of machines used in theatres. But all of them have certain features in common. There is always a light-source, a collective element to form an image of the source at or near the film gate, and a projection lens to image the film upon the screen. All but one of these five parts of the optical system are subject to wide variation in practice, and that one is the aperture of the film gate. The useful light that is transmitted to the screen must pass through that opening. It is a convenient point, therefore, at which to evaluate the total light output of the projector.

Suppose that a projector is arranged to image the film aperture upon a distant screen, and is at right angles to the screen and properly centered. Neglecting reflection and absorption losses again, the screen illumination will, in general, not be uniform. There will always be less light at the margin of the screen than at the center, and the loss increases progressively from the center to the margin. There are two reasons for this condition. The margins of the screen are farther from the lens than the center; and the lens points directly at the center of the screen, whereas to any marginal point it presents its surface at an angle. This loss in marginal illumination is not large in the case of an ideal optical system. With a 3-inch focus projection lens, for example, it amounts to 5½ per cent at the extreme corner of the screen. It will be considered again later, together with the losses that occur under practical conditions.

Projector Light Losses

Thus far no account has been taken of the losses of light that occur in any practical projector. These loss factors must now be estimated in order to establish a basis for the light yield of any actual optical system. In making the estimate some regular procedure is advisable, so we shall start at the light-source and follow the path of the light through the projector.

The brightest sources available for projection are arc lamps. They have been measured by methods described in the literature, and many reports of their performance have been published. From these data Fig. 1 has been prepared, to show the intrinsic brilliancy of typical arc lamps as used in practice. The range is from 165 candles per sq. mm. for the low-intensity arc to 750 for modern high-intensity carbons. It should be noted. first, that the arcs can be operated at currents higher than the manufacturers' ratings, with a resulting increase in brightness; and second, that the brightness level indicated in Fig. 1 is attained only at the crater of the arc and is an average figure for the area of the crater. The outer part of this area is not generally as bright as the center, which fact is one cause of the lower illumination at the margins of the screen.

In the outline of an ideal optical system the source was assumed to be perfectly diffusing, which meant that it appeared equally bright from every direction of observation. The arc crater used as a source in practical projectors does meet this specification approximately, within the angle included by the collective element. The only exception that need be noted occurs when the negative carbon or the carbon holders cut off part of the useful light that would otherwise pass through the film gate.

In the case of condenser lamps this is not a factor. In good designs there is no shadowing by the mechanism or the negative carbon. There are losses in condensers due to reflection and absorption, which vary with the number of elements and the thickness and quality of the glass. The condensers now used are usually of the two-element type, the losses ranging from 17 to 25 per cent; 20 per cent is a good average for modern practice. It will be convenient to express all these factors as transmission, and call this one a condenser factor of 80 per cent.

With reflectors the light lost through absorption and reflection at the surface is less, but there are other factors that reduce the efficiency. The negative carbon obscures part of the reflecting surface, and the glass must be pierced to provide space for feeding the carbon. The positive carbon assembly also interferes to some extent. These factors, in addition to a small allowance for loss at the silvered surface, make the total loss in a practical reflector lamp about equal to that in the condenser type. There is the usual variation in different designs. Eighty per cent will be taken as the transmission factor of the collective system.

The light now proceeds to the film gate, losing on the way a full half of its volume due to the mechanical cut-off of the shutter. *The shutter factor is* 50 *per cent.* At the plane of the film no losses will be assumed: this loss involves the density of the release print, and will not be considered here. All the data to be presented are computed upon the basis of a complete projector

*Journal of the S.M.P.E., XXVI (May, 1936) No. 5.

with shutter operating, but without film in the machine.

Next in order is the projection lens. Many types of objectives are used in theatres. All have loss-factors due to reflection at the free surfaces and to absorption in the glass itself. The transmission of commercial lenses varies from 63 to 80 per cent, depending principally upon the number of free surfaces in the glass elements. Most of the lenses in use are of the Petzval type, in which the transmission averages 75 per cent.

There is another cause of loss, however, to be considered in connection with projection lenses. It was mentioned earlier that even in an ideal system the illumination at the edges of the screen is inferior to that at the central region. This fact is a result of the space relations involved in projection, and is unavoidable. Practical lenses are so constructed that they make the condition worse, as illustrated in Fig. 2. Due to the length of the projection lens, the full area of its front surface can not be filled with light for the margin of the picture area. These two factors operate together to reduce the marginal illumination considerably, and the effect grows worse as the focal length of the lens decreases.

In Fig. 3 are shown the computed values of these factors for typical *f*/2.5 projection lenses of 3- to 6-inch focal length. The value given for each focal length is an average of the calculated transmission for thirteen different points evenly spaced over the picture area, and is a reasonable estimate of the loss in screen lumens due to the two conditions just described. The factor is 56 per cent for a 3-inch lens, and 86 per cent for a 6-inch lens. Eighty per cent is a good average for the purpose of this estimate.

The results of combining all these data are given in Fig. 4, which shows an efficiency of 24 per cent for the entire optical unit. This diagram is useful in many ways. In respect to light-sources, the bottom curve represents the limit of illumination to be expected from lamps using low-intensity carbon arcs. The upper curve gives the same information for large high-intensity carbons. The middle curve is the brightness level

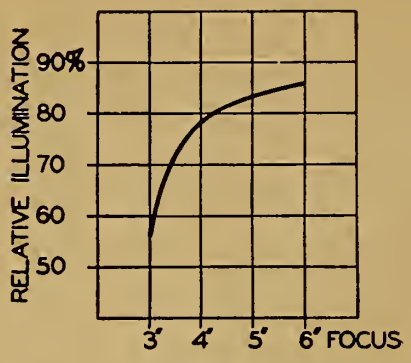


FIGURE 3

Reduction of marginal illumination with focal length of lens due to effect illustrated in Fig. 2

of the 7-mm. high-intensity non-rotating carbon. The range is from 2350 to 10,600 lumens with optical systems of *f*/2.0; and from 1650 to 7500 lumens at an aperture of *f*/2.4. The result of a change in relative aperture can be derived in a similar manner. The largest aperture that need be considered at present is *f*/2.0, for reasons that will appear shortly.

These results indicate the number of lumens that a well designed projector should deliver to the screen. It is not to be expected, however, that even the best of modern commercial projectors will attain this level. It was pointed out in the discussion of light-sources that the outer edge of the arc crater is not as bright as the center in high-intensity carbons. This causes a loss of light at the margin of the screen; the projection lens has the same effect even when it is *completely* filled with light.

There is little to be gained by increasing the aperture of the projection lens beyond *f*/2.0 at the present time. An *f*/2.0 optical system can not be assembled simply by taking out an old *f*/2.4 projection lens and putting in a new one of *f*/2.0. To get a real increase in relative aperture the collective element must also be large enough to fill the larger angle of the new lens.

The practical result of these three deficiencies in marginal screen light is this: When the system is adjusted for maximum light output, the corners of the picture are too dark; to correct this the arc is re-focused and the source image moved out in front of the film gate until the distribution of light between the margin and the center is deemed satisfactory. At this adjustment the optical system no longer gives its maximum output.

It is not possible to present here the actual measured yield of any type of commercial machine as installed in the theatre. No sufficient information has been published. Measurements made under laboratory conditions indicate that the maximum output to be expected from commercial projection systems is in the neighborhood of 5000 lumens with higher intensity. There is no essential difference between condenser and reflector lamps in this respect. Low-intensity reflector arcs furnish about 1250 lumens under these conditions, and lamps using the 7-mm. non-rotating carbons, 4500 lumens.

It appears, then, that available projection machines can provide 5000 lumens of screen light. The exact figure is of little importance, in view of published reports of differences as great as 100 per cent between two projectors installed in the same theatre[1]. The output varies, probably, all the way from 700 lumens to 4500, in what may be called the entire scale of arc illumination in theatres.

In applying this lumen output to the screen area and estimating the resulting screen brightness, the 1931 S.M.P.E. Screens Committee gives complete data. Apparent screen brightness for a given amount of illumination varies with the character and reflectivity of the screen material, the angle, the position of the observer, and the amount of stray light

[1] This opinion was expressed in the paper, "Some Technical Aspects of Theatre Operation," by H. M. Wilcox and L. W. Conrow, of Erpi. Frankly, I. P. always regarded this particular paper as the first gun in Erpi's campaign to popularize all-inclusive servicing, its commercial flavor being apparent. The statement relative to variances of 100% between projectors in the same theatre was accepted by I. P. as "scare copy." Extremist statements of this character ring strangely hollow coming from representatives of sound equipment companies, which have unfailingly exhibited a passion for "averages." Moreover, even the worst technical zanny would have no trouble in detecting a variation of 100% in projector light output.

Inclusion of this opinion in the accompanying paper, in I. P.'s opinion, certainly adds nothing to its worth.—Ed.

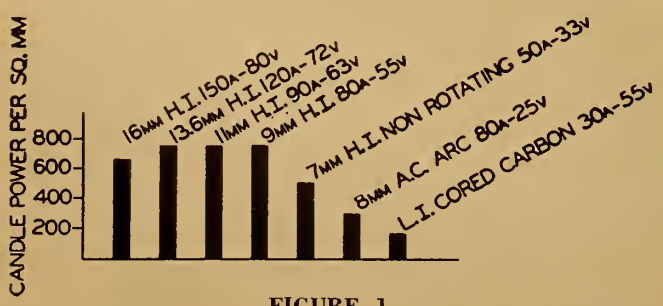


FIGURE 1

Intrinsic brilliancy of typical arc lamps as used in practice

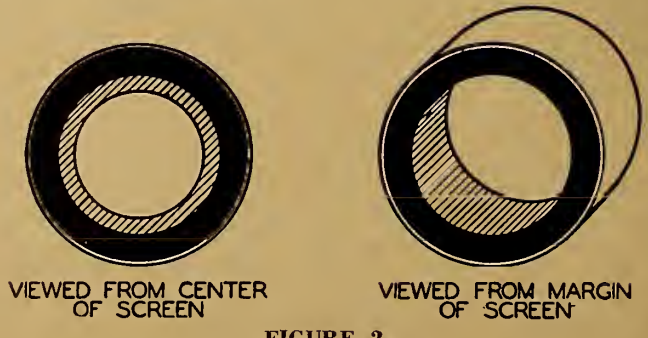


FIGURE 2

In practical lenses the full area of the front surface is not filled with light for the margins of the screen picture area

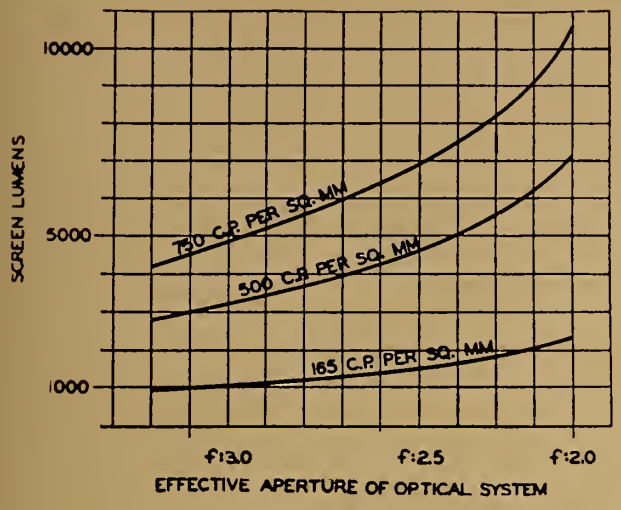


FIGURE 4

Available screen lumens, after allowing for losses

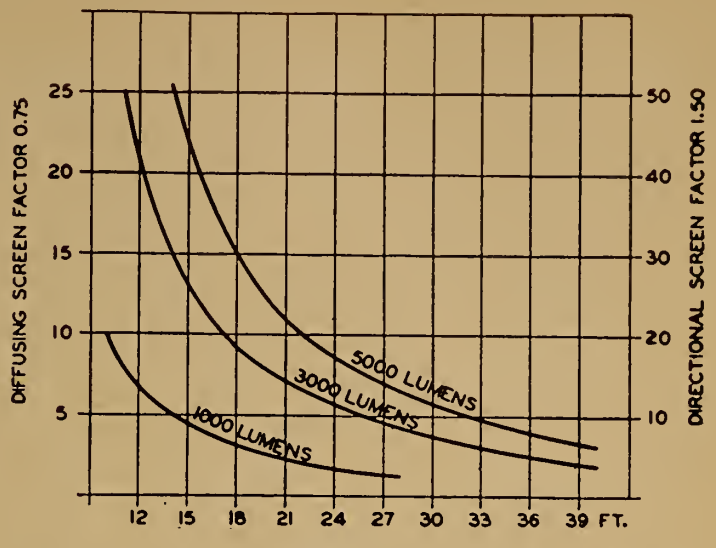


FIGURE 5

Screen brightness in foot-lamberts for diffusing and directional screens. Screen width is the dimension specified

that reaches the observer's eyes from other objects within his angle of vision. The last two of these factors are outside the scope of this paper.

Types of Screens

Two kinds of screens will be considered here. The diffusing type is used in theatres when a wide angle of seating area is to be covered, and has, in general, a reflection factor of 80 per cent when the projection angle is 15 degrees. In long, narrow houses, a directional type of screen can be used, which has the property of building up the apparent brightness over an angle of about 20 degrees. Direct reflection from finely divided specular material upon the screen surface is responsible for this result, and the reflection factor of such screens, in terms of apparent brightness, is 160 per cent, according to the 1931 Report. This value applies also to a projection angle of 15 degrees, which is regarded as an average in commercial practice.

There is also a loss of 5 to 8 per cent in reflecting area to be combined with these factors, due to the perforations for sound transmission. Accordingly, the values 75 and 150 per cent have been used in compiling the data for the curves of Fig. 5. Screen width is plotted along the horizontal axis and apparent brightness in foot-lamberts† along the vertical axis. The scale at the left applies to a diffusing screen; on the right, to a screen of the directional type. Curves have been drawn to show the average apparent brightness of the screen for projector outputs of 5000, 3000, and 1000 lumens. These curves apply when the projection angle is 15 degrees. When the angle increases to 30 degrees, the loss of brightness occasioned thereby is about 7 per cent for the diffusing screen, and 50 per cent for the directional screen. It is evident that directional screens are of little value when the projection angle exceeds 20 degrees.

Source brightness and effective aperture are the fundamental factors that determine the lumen output of any projection optical system. Variations in current or carbon spacing causes large changes in the brightness of the arc crater. Small differences in the position of the source in relation to the collective element can rapidly reduce the effective aperture. These variable quantities must be carefully controlled in order to get consistent results from the optical system. It is often possible to achieve a large increase in brightness at the center of the screen and an increase in total lumens by sacrificing at the margins. Any standard that may be established should certainly include a definition of what constitutes uniform illumination and a specification of the points at which it is to be measured.

† NOTE: For all practical purposes, the term "foot-lamberts," employed in these papers, is and may be considered as identical and having the same value as the more commonly used term "foot-candles".

2. An Analysis of Theatre and Screen Illumination Data

By S. K. WOLF
ELECTRICAL RESEARCH PRODUCTS

MOTION pictures projected upon a screen illustrate a wide range of conditions. Brilliant daylight scenes are depicted along with others supposedly representing pitch blackness, and all the variations intervening between the two extremes. In technical terms this means brightness variations ranging from about 10,000 foot-lamberts to less than 0.0001 foot-lambert, for reflected light. The ratio is about 100,000,000 to 1. When we contrast such figures to those available in the theatre we realize the severe limitations governing motion picture equipment. A corallary to this is the importance of taking advantage of human adaptability in order to achieve a satisfactory illusion in the theatre. Because of various physical limitations, the maximum of screen brightness in the theatre is usually less than 15 foot-lamberts, with a minimum of more than 0.15 foot-lambert, a ratio of less than 100 to 1.

In the theatre, then, we are limited to a comparatively small range, situated approximately at the middle of the natural scale of reflected light values. A saving factor in this connection is that under any one condition of illumination, the contrasts involved in most scenes more nearly approach the range available upon the screen. Another point is that the brightness values characteristic of projection approximate those regarded as normal for interiors. Greater values are generally impracticable with the magnification necessary in projection and the limitations imposed upon light-sources.

Another factor materially changes the complexion of the situation. The stage is the center of interest; the immediate surroundings are of no concern. We, therefore, blot them out by darkening the theatre, not only for motion pictures but in the legitimate theatre as well. Concentration upon the stage is thereby facilitated. It is apparent, therefore, that the theatre must be kept relatively dark.

If, under the circumstances, we at-

tempted to project high values of illumination upon the screen such as are encountered out of doors, a host of psychological and physiological factors would come into play. High illumination would be uncomfortable in contrast with dark surroundings. Rapid sequence of scenes, involving great changes of light values, would strain ocular power of adaptation. The contrast of images projected upon the screen is limited by "flare" of the objective lens. In this connection, it should also be observed that it is deemed good practice to provide ambient light in order to permit the patrons to find their seats, to avoid glare, etc., and that thus some light will be reflected back upon the screen and the contrasts reduced.

The result of this combination of factors is that illumination of the screen has an upper, a lower, and variation limits determined by physiological requirements. Similar limits are imposed also by projector and film capabilities. The function of engineering is to make the physical possibilities at least great enough to take advantage of the full range permitted by the physiological factors. The determination of such requirements should be the task of physiologists and psychologists, but engineers have been able to establish tentative relations which experience has indicated as satisfactory if not optimal.

Theatre Illumination Level

We have seen that theatres should be maintained dark in order to promote concentration. In some countries, for example, in Germany, it is customary to provide no illumination other than that reflected from the screen[1]. In other countries, sufficient ambient light is provided to permit theatregoers to find their seats and to read their programs with moderate ease. In the United States programs in motion picture theatres are uncommon, but it still appears desirable to make allowance for both conditions, for possible emergencies, and also to relieve the effect of the glare experienced when passing from the bright exterior to the dim interior of the theatre. Upon the basis of general principles governing illumination practice, it seems undesirable that all the light in the auditorium be due only to reflection from the screen.

Practice governing ambient theatre illumination has become fairly well stabilized. The light-sources should be low-level, and not directly visible. Indirect illumination is much to be preferred, in order to avoid glare in the auditorium. The light-sources should be so arranged that as little stray light as possible reaches the screen. Otherwise, the contrast of the screen image may be materially reduced. For that reason, as well as to reduce eye-strain in transition from exterior to interior, it has been recommended that somewhat greater general illumination be provided at the rear of the theatre than at the front, which would seem a reasonable procedure in view of the fact that the intensity of the reflected light is greater near the screen.

In 1920, Jones[2] recommended that general illumination of the order of 0.1 foot-candle be provided at the front, with gradually increasing amounts toward the rear, up to a value of 0.2 foot-candle. These figures apply to a light striking a horizontal plane. He found that under such conditions the picture contrast was not materially reduced, provided that the requirements outlined above have not been violated; in fact, the eye became more sensitive to small brightness differences in the picture. Jones further recommended that no visible area (outside the projected picture) have a brightness in excess of about 2.8 foot-lamberts. These recommendations are a satisfactory compromise for general illumination in theatres.

Screen Illumination Level

Screen reflectivity is inextricably associated with illumination. We are interested not so much in the quantity of light incident upon the screen as the quantity being returned to the audience. We should, therefore, concentrate upon screen brightness as the primary factor, since it includes both illumination and reflectivity. That has not always been done. Another item not to be overlooked is the intermittency of projection. The screen is alternately fully illuminated and darkened. Our eyes do not follow the variations, but tend to integrate them. The resulting perceived brightness is approximately, at least, the time-average of the instantaneous brightnesses, and is accordingly proportional to the shutter opening, normally about 50 per cent. To avoid confusion, therefore, measurements should be made with the shutter running. Unfortunately, that has not always been done, and as a result some uncertainty is present in existing data.

Assuming this precaution taken, measurements then indicate brightness without film in the projector. The brightness of a screen with film in the projector obviously depends upon the density of the film. Even unexposed film, however, appreciably reduces the illumination falling upon the screen. Hence, measurements without film serve only as guides. Judgments as to acceptable initial screen brightness must be made for a particular screen illumination and a particular film. However, film processing has become more nearly uniform, and in the theatre it is not customary to make allowance for variations in the average density of black-and-white release prints.

For colored prints, it is believed that somewhat more light might be used, although projector limitations generally render that impracticable.

The data accumulated in the past show a gradual rise, with the passing of time, in the illumination regarded as satisfactory. However, they represent measurements made under various conditions, and are not strictly comparable; and, furthermore, differing reasons, or no reasons at all, were given for arriving at the various recommendations.

Resume of Recommendation

In 1917, Dennington[4] stated that an intensity of 3 foot-candles projected by an incandescent filament source was as satisfactory as an intensity of 4.8 foot-candles projected unsteadily by an arc source, the shutter in both cases being stationary and no film in the machine. With a diffusing screen, these values would at present be considered low, but with a specular screen would give rise to relatively high brightness values over a limited viewing angle. Also about this time, Burrows and Cardwell[5] conducted a demonstration before the S.M.P.E. illuminating a diffusing screen to intensities of 1, 10, and 25 foot-candles, without film or shutter. The consensus was that the first of these values was inadequate, the second not excessive, and the third so glaring as to cause loss of distinction in picture projection.

In 1918, Kunzmann[6] published a curve showing required candlepower vs. screen area. The smaller screens were demonstrated as needing more light than the large ones. For example, an intensity of 10.6 foot-candles was recommended for screens 50 sq. ft. in area, and 8 foot-candles for an area of 200 sq. ft. These values are presumably without film or shutter. The question of variation with size will be discussed later.

In 1920, Jones[2] found that about 14 foot-lamberts was the average screen brightness for several Rochester theatres, apparently without film but with

Major Producers Who Have Approved Double Reel

Universal's approval of the proposed industry standard for a 2000-foot reel makes unanimous the action of all major companies relative to this project. Columbia, Metro-Goldwyn-Mayer, Paramount, RKO-Radio, Twentieth Century-Fox, United Artists and Warners had previously approved the new reel length.

No definite word relative to the attitude of independent producers on the longer reel has yet been forthcoming.

the projector running. Jones stated that these values were higher than those obtained in normal practice. No comment was made as to the acceptability of this value of brightness.

Next is the report of the S.M.P.E. Theatre Lighting Committee of 1928[7]. In a series of tests the screen illuminations varied from 5 to 14 foot-candles, without film or shutter. In 1930, the Committee reported[8] that a screen brightness of about 22 foot-lamberts would be distinctly uncomfortable against a dark background from a distance of 24 feet. At a distance of 72 feet, discomfort would be almost imperceptible. This report mentioned a recommendation by the Japanese National Committee on Cinema Lighting to the International Commission on Illumination, specifying an average light intensity of 2.3 foot-candles upon the screen, film and shutter conditions not mentioned.

In 1931 the Theatre Lighting Committee[3] reported the results of a rather comprehensive series of tests in seven theatres. The screen illumination (without film but apparently with shutter running) was found to vary from 2.6 to 10 foot-candles, with brightnesses ranging from 2.2 to 9.3 foot-lamberts. Screen brightness of less than 2.8 foot-lamberts were found unsatisfactory due to the reduction of visual acuity. The higher values were found good in regard to visual acuity.

Some Foreign Data

In 1931 the Japanese Secretariat Committee on Cinema Lighting recommended[1] a screen illumination of 9.3 foot-candles, presumably without film or shutter. This recommendation was based upon the assumption of an intensity of 0.18 foot-candle for the general theatre lighting. Under these conditions, picture contrasts were not seriously affected. Higher values of screen intensity were stated to be unobjectionable. Measurements in eleven principal Tokyo theatres showed screen intensities varying from 3.1 to 9.3 foot-candles, with no correlation as to screen size. The average was 6.35 foot-candles, considerably below the recommended value. An idea of the screen brightnesses may be obtained from the fact that some of the screens were of American manufacture and, hence, about 80 per cent reflecting when new.

In the report was also included a resume of findings of a German National Sub-Committee, who stated that in ten German theatres the screen illumination varied from 6 to 16.8 foot-candles, at the screen centers, shutter and film conditions not mentioned. There was again no correlation with respect to size. The average intensity was 9.5 foot-candles. The reflectivity of the screens varied from 42 to 90 per cent, with 60 per cent as the average, and no correlation as to the light intensity used. The maximal screen brightness was 9.7, the average 5.8, and the minimal 2.6 foot-lamberts.

In their table of data, the German Committee included a column showing the "required" screen intensities in the various theatres, the screen widths, the theatre seating capacities, and the projection distances. How the "required" illuminations were determined is not explained in the text of the available printed report. The required intensities ranged from 7 foot-candles for a screen 13.8 feet wide to 11.4 foot-candles for a screen 22.3 feet wide.

A resume of the data shows that values of screen illumination ranging from about 1.5 to 20 foot-candles have been regarded as satisfactory at one time or another (these values are with shutter running, obtained from the data given above by applying the proper corrections). Taken as a whole, the data are scant, inconclusive, and insufficiently substantiated, so that no definite recommendations may be formulated from them. The lower values do not now represent good practice. Many of the later data fall in the range of 8 to 12 foot-candles, recommended for interiors by illuminating engineers. This may be a coincidence, but a tenable supposition is that some relation exists between the two situations. Brightness values of pictures projected upon normal diffusing screens within this range of incident light intensity approximate brightness values found desirable for interiors. It would appear reasonable to infer that such conditions in the theatre are not far from correct. Upon the basis of practical considerations, we arrive at the same conclusion. Practice evolving through years of experience is likely to be at least approximately correct.

Effect of Screen Size

A question that frequently recurs in the literature concerns the variation of required brightness with the screen size and the distance from which the screen is viewed. It will be remembered that the surface brightness of a screen is independent of viewing distance except for atmospheric absorption. From our own everyday experience, as well as from the recommendations of illuminating engineers, we know that for good vision, small objects require higher illuminations than large objects. We might expect that higher screen brightnesses would be desirable for those at the rear of the theatre, since the screen images appear smaller. Judging from the scant published information [8, 9] that has been found to be the case. It has also been generally conceded that smaller screens should be more brightly illuminated than are the larger ones.

These two phases of the same fundamental question must be considered together. Unfortunately, in the past there has been a tendency to treat them separately. As a result, what few data there are lack definite quantitative significance, and may even appear superficially contradictory.

As mentioned, Kunzmann in 1918 published a curve showing the required candle-power vs. the screen size, more light per unit area being needed for the smaller screens.[6] The variation shown was comparatively small, about 1.3 to 1.0 for a variation of screen width of 1 to 2. No reasons for the variation were advanced.

The brief report of the German National Sub-Committee on Cinema Lighting[1], already mentioned, cited data on specific theatres. The two extreme cases will be described: The smallest screen was 13.8 feet wide, and, with a projection distance of 49.2 feet apparently required an illumination of 7.05 foot-candles. The largest screen was 22.3 feet, the projection distance being about 151 feet and the required light intensity 11.4 foot-candles (shutter and film conditions not mentioned).

It will be noted that the ratio of screen widths is the same as that of the required illumination, i. e., about 1.0 to 1.6. The influence of projection distance is not stated, nor is it apparent from the data. Similar relations exist in the other cases, which fall between these two extremes. The required illumination increases directly with the screen width. No reasons for this are presented. Kunzmann's curve varied in the opposite direction, in agreement with other experience in this country.

In the discussion following a report of the Projection Screens Committee[9], Farnham stated that for an increase of screen width from 4 to 22 feet, a ratio of 1.0 to 5.5, the screen-brightness could be reduced to a half or a third of the value required for the small size.

The factor of viewing distance considerably alters the situation, however. A large or small screen apparently requires a smaller or greater light intensity, depending upon the viewing distance. The figures just presented exclude this factor, and hence definite conclusions can not be drawn. The literature contains references to the desirabilty of increased brightness at greater viewing distances, but no quantitative data seem to be available. In any case, it is difficult to see how any allowance for this factor could be made practically in existing theatres. It seems impossible to design screens to have special reflection characteristics in different directions, with each unit of area

(*Continued on page* 23)

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

Independent Supply Dealers Chicago Meet, June 5-8

THE Sixth Annual Convention and Trade Show of the Independent Theatre Supply Dealers Association will be held in the Edgewater Beach Hotel, Chicago, June 5 to 8, inclusive. Dealers from every section of America will gather to consider their experiences of the past year, consider mutual problems and lay plans for the ensuing year. Participating in the Convention will be many manufacturers and guests representing various branches of the industry, some of whom will address the assembly.

Extensive Equipment Exhibit

One of the most interesting features of the Convention will be the large exhibit of standard and new equipment, with representatives on hand throughout the sessions to demonstrate the design and operation of the units. A special session, designated as the "Manufacturers Conference," has been arranged for an exchange of ideas between makers and sellers of equipment. Suggestions received by the dealers from exhibitors and projectionists can be relayed to the manufacturer. This Convention will attract more visitors and have the most extensive equipment exhibit of any up to date, according to J. E. Robin, executive secretary.

The business sessions will open immediately following registration at 9 a.m. on June 5. Closed sessions for members only will be reduced to the minimum necessary for transacting Association business. Fitting tribute will be paid to the memory of Clem Rizzo, of Philadelphia, and E. E. Oliver, veteran supply dealers, whose untimely deaths recently robbed the organization of two outstanding members.

Addresses on Many Topics

Among those who will address the assembled supply dealers are: E. A. Williford. National Carbon Co.; Nat Golden. U. S. Dept. of Commerce; A. Wienke, who will discuss the new Motiograph projector; Capt. John Corby, on standardization; J. B. Kleckner on dealer financing questions; Charles R. Schatten on advertising, and James J. Finn, who will discuss projectionist-dealer relations.

Figuring importantly in the proceedings will be an evaluation of the promotional campaign launched by the Association at the 1936 convention. The intensive advertising and publicity campaign. with which was tied in local promotion of the Association insignia, has evoked widespread comment and approval.

One indisputable effect of the dealers' campaign has been to broaden the campaigns of those equipment manufacturers already advertising. and to occasion a resumption of promotion work by those who had not engaged in such activities during the preceding years—an indirect but positive aid to dealer sales.

The annual dinner of the Association will be held on Saturday, June 6, at 7:30 p.m. Election and installation of officers for 1936-37 will round out convention activities.

Canadian Locals Establish Organization Bulletin

Canadian units of the I.A. have launched a monthly Bulletin under the direction of Arthur Milligan of Toronto Local 171. Organization, social and technical matters are discussed in very readable language and combine to form a publication which should prove of great value in establishing closer relations between Canadian units.

Double Technicolor Business

The present capacity of Technicolor laboratory is 75 million feet a year, which will be doubled by expenditure of $1,500,000. Technicolor's 1936 business on features and shorts is double that of 1935; while advance plans for 1937, with at least 20 features set for color, indicate doubling of this year's business.

Erpi and Banker Influence Strong in Par. Set-Up

The how and why of things that are done in Paramount's struggle for comeback from receivership interests close observers of industry happenings. Paramount owed Erpi great chinks of money just prior to receivership for former. Result: John Otterson, then head of Erpi. was named president of Paramount. Today Erpi is credited with owning 6000 shares of Paramount preferred stock.

Obvious weakness of Paramount presently is lack of picture people in high places. Result: Percy Johnston, head of Chemical Bank (N.Y.) resigns from Paramount board. He is replaced by Harvey Gibson, head of Manufacturers Trust. At the same time, S. Griffis, of a N. Y. investment security house, is added to board. It's a great world.

Clem Rizzo, Supply Man, Dies

Clem Rizzo, for 30 years a theatre supply dealer, and charter member and treasurer of the Independent Theatre Supply Dealers Assoc., died on April 27 following an operation for acute appendicitis. He was 45 years of age.

RCA Non-Slip Printer Rights on Royalty-Free Basis

Any producing company or motion picture laboratory interested in using the new RCA non-slip printer patents may apply for a royalty-free license to construct similar printers or to alter existing printers to obtain similar advantages, according to an official RCA announcement. These patents cover an entirely new principle of sound picture printing. This is the first instance on record where a royalty-free license has been offered to the industry generally by any sound company.

National Fire Assoc. Gives Double Reel Approval

The proposed standard 2000-foot reel, scheduled to make its bow on Aug. 1, will be recognized on the same basis as the 1000-foot reel by the National Fire Protective Assoc., its annual meeting decided, after the committee on hazardous chemicals and explosives recommended this move. "subject only to the standard limitations as to total weight of nitrocellulose film permissible in certain situations. Otherwise the double reel does not increase the fire hazard."

Eastman's New 'Kodacolor' Process for 35 mm. Market

Eastman Kodak is now conducting practical tests in Rochester theatres of its new Kodacolor process for motion pictures, according to reliable reports. Results attained with this 35 mm. process are said to approximate in quality the Kodachrome 16 mm. system which has won universal approval.

Although Eastman officials decline to comment other than to say that the new 35 mm. color system will not be available for 1½ years, well-informed observers hold that the process will be perfected within four months.

British Film Television Soon; RCA Test Image 5" x 7"

Television on a commercial basis will be inaugurated in England on July 1, when the British Broadcasting Corp. will open a station in London. A 25-mile radius is claimed for the B.B.C. system, although nothing definite regarding this or the number of receivers available has been forthcoming. Most of the opening program will be televised from film, which procedure is expected to be standard practice in the art.

RCA's recent demonstration of television outdoors produced an image on the receiving end of only 5 x 7 inches, which, however, was reported as quite clear. Field tests will begin sometime in June from a transmitter installed atop the Empire State Building in N. Y. City

REVIEW OF SCREEN AND THEATRE ILLUMINATION DATA

(*Continued from page* 21)

different in its directional properties.

So far as good engineering practice is concerned, it should suffice to choose the screen size as a function of maximal viewing distance. The size then would determine the distance of the nearest seats. With these precautions taken, the range of the solid angle subtended by the screen would be approximately the same from theatre to theatre. The brightness of the screen may thus be made relatively uniform for all theatres. This conclusion is a theoretical one, but is at least partially substantiated by practice. A large projection equipment firm attempts to follow this principle.

Brightness of Screen Frame

The brightness of the screen frame is the last item to be discussed in the present analysis. A projected picture should have some definitive border, for esthetic reasons, to promote attention and to reduce "jumpiness" of the picture. These requirements must be met without introducing too great a contrast in the field of vision. According to Jones[2], a border of neutral gray surrounding the screen is more pleasing than is a black one. A black border is more likely to give rise to a feeling of visual discomfort because of excessive contrast with the projected picture.

Jones's recommendation was that the border should be at least $^1/_{1000}$, preferably $^1/_{500}$, as bright as the screen highlights. Since the illumination incident upon the borders is somewhat less than that upon the screen proper, the reflecting power of the border should be somewhat greater than $^1/_{500}$ that of the screen. With black velvet borders, the possible contrast has been estimated to be about 1 to 10,000.

The Theatre Lighting Committee also advocated that screen surroundings have appreciable reflecting power.[3, 8] Black borders were found to be acceptable in relatively narrow theatres. Comfortable conditions, apparently regardless of width, were obtained with gold, yellow, or similar surroundings about the screen. The brightness of the surroundings was about 0.047 foot-lambert, as against approximately 100 times that for the screen.

Practical considerations lead us to believe that there is nothing radically wrong with the values of theatre and screen illumination in common use. If there were, reports of discomfort would be a great deal more frequent than they are. This observation is a comforting one, but does not warrant the cessation of further investigation. It merely gives us some assurance that we may temporarily halt at our present position while additional information is gathered. In the meantime, some improvement may be made in theatres at present by stricter application of the recommendations already made by qualified authorities, remembering that good illumination results only from proper integration of a group of interdependent factors.

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[3] Report of the Theatre Lighting Committee, *J. Soc. Mot. Pict. Eng.*, XVI (Feb., 1931), No. 2, p. 239

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FINAL REVISION OF DOUBLE REEL FOR AUG. 1 BOW

(*Continued from page* 16)

shown at "A" on the accompanying drawing.

Reel flanges shall have a sufficient area of flat contact surfaces on the inside to provide ample bearing for the edges of the film. Rib heights shall be slightly less than the height of the peripheral rolled edge to allow for stacking. All flanges shall be free from warping or buckling after assembly and shall run true within 1/32 inch when the reel is spun on a 5/16 inch shaft.

Center bushing shall fit solidly into side flanges without looseness when assembled, and shall be of sufficient strength to withstand the wear and tear of usage. Clinching ears shall fit tightly and shall be pressed down firmly so as to make a solid assembly of the reel and to insure at all times a 1/16 inch slot for threading the film end into the hub.

Material, Finish, Weight, Cost

Material shall be steel with anti-corrosive plating or coating, or non-corrosive alloy. Finish shall be suitable to protect against the wear of use and against the corrosion of ordinary atmospheric influences. To allow for the utmost freedom in design of the reel, maximum and minimum dimensions are indicated on the drawing wherever possible, but where such values are not shown, the specific dimensions shall be strictly adhered to within the limits of good practice. The total weight of the reel and its cost price must be closely comparable to two first class reels of 1000 feet film capacity. Any cheapness in the reel made possible by weak construction shall be deemed unsatisfactory.

Any concentric grooving in the flanges which will permit layers of film to shift laterally shall be considered unsatisfactory. Enamel or paint finishes are not recommended and unless they offer exceptional resistance to wear and chipping shall be considered unsatisfactory. Any reel on which the plating or dipped finish cracks during forming or assembling shall be considered unsatisfactory.

Manufacturers preparing standard reels meeting these specifications should take whatever precautions may be necessary to assure themselves that they are not infringing any existing patents which cover the features suggested in the specifications.

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RECORDING, LIGHTING, 16MM. SOUND-FILM PROGRESS, FEATURE S.M.P.E. MEETING

(*Continued from page* 11)

of any widespread industry demand for the optical projector, the author said that the availability of his projector would create a demand therefor.

Wide advances scored by 16 mm. sound-on-film were cited in a symposium devoted to non-theatrical equipments. Gains have been registered chiefly in the educational and industrial fields, it was said, with continued improvement in recording and reproducing processes and equipments presaging even greater strides forward by such equipments during the coming year. National advertisers were shown to be large users of 16 mm. sound films, several large automobile companies employing road-show units the year 'round.

It was decided to hold the next Convention of the Society in Rochester, N. Y., Oct. 12-15, inclusive. The newly elected officers of the Society will assume their duties on January 1 next. Abstracts of those papers considered to be of particular interest to projectionists are appended hereto:

PROGRESS COMMITTEE REPORT

THE Progress Report for 1935 shows decided advances in both professional and amateur cinematography, in sound recording technique and equipment, as well as in sound reproducing systems, for general theatrical usage. Outstanding in the field of cinematography, although confined at present to the amateur field, is the new Kodachrome color film. 1935 was also noteworthy for the extension of the three-color Technicolor to feature production.

Several advances are reported along the lines of new silent cameras for professional work. Very interesting has been the polarizing filters introduced by Eastman, which should prove a great aid to both professional and amateur cinematography ("Polaroid").

In the field of lighting, interesting developments are reported in connection with the development of new gaseous conductors, which threaten to revolutionize the field of lighting as well as to comprise new sources of projection lamp arcs. New lens spots utilizing the Fresnel type of lens was introduced successfully in studio work this year.

In sound recording the development of the push-pull method of recording received impetus following demonstrations before the S.M.P.E. Convention in Hollywood. Considerable interest has been aroused by the announcement of RCA of the use of Ultra-Violet light recording. New theatre systems involving new methods of pulling film, as well as introduction of the new type of multicellular type of horn, commonly known as the Fletcher horn, have been offered to the public during the past year.

SOUND COMMITTEE REPORT

Progress being made on the projects assigned to the committee is discussed. These include the study of frequency response characteristics of release prints made by the use of the Sound Committee's frequency reference standard. The report does not include any conclusions or data relative to these projects.

HARMONIC DISTORTION IN VARIABLE DENSITY RECORDS

Burton F. Miller

Warner Bros.-First National Studio

This paper consists of two portions, the first being concerned with a derivation of the equations expressing the exposure waveform on variable density records obtained by means of the light valve under conditions of sinusoidol ribbon modulation and known overall photographic sound track gamma. Curves indicating the theoretical percentage of second and third harmonic print distortion are plotted against frequency, several values of overall gamma being assumed. It is shown that the distortion at low frequencies is almost exclusively due to departures of the overall gamma from

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unity, while the distortions at high frequencies are mainly dependent upon the velocity of the light valve ribbons.

The second portion of the paper is devoted to the presentation of experimental distortion data obtained from variable density frequency data obtained from variable density frequency films, and the comparison of this data against that obtained from the theoretical analysis.

THE ELECTRON IMAGE TUBE: A MEANS FOR MAKING VISIBLE, INFRA-RED IMAGES

B. A. Morton

RCA Manufacturing Co., Inc.

The paper describes construction and theory of operation of the electron image tube. This tube consists of a photosensitive cathode, a fluorescent screen, and an electron optical system which focuses the "electron image" from the cathode onto the viewing screen. Due to the wide region of spectral response of the cathode, the tube can be used to convert infra-red, visible, or ultra-violet images into visible images on the fluorescent screen.

The Electron Optical System

The electron optical system used in the image tube is discussed in detail, and the analogy between the electronic system and a conventional optical system is shown. In order to reproduce faithfully an image projected on the photosensitive cathode, the electron "lens" system must be connected for various aberrations, such as curvature of the image field, distortion of the image, etc. Methods of making these corrections are indicated.

Various applications of this type of electronic device are described and illustrated.

RCA ULTRA-VIOLET RECORDING

G. L. Dimmick

RCA Manufacturing Co., Inc.

The resolution of sound film records has been increased by the use of ultra-violet light in recording and printing. Because of the absorption characteristics of the emulsion, exposures made by ultra-violet light are restricted to the surface, which reduces the spreading of the image. The fogging of the track which usually results from halation and reflection from objects in the path of the light is almost entirely eliminated. Since

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the light energy is restricted by means of a filter to a very narrow band, the chromatic aberration of the lenses is reduced.

The definition of the very fine recording light beam is limited by diffraction. This limitation is materially decreased as a result of the decrease in wave-length of the radiant energy.

THE ACOUSTIC DESIGN OF SCORING STAGES

C. M. Mugler

This paper describes and discusses the design of the scoring stage built at Columbia Pictures Studio. The stage follows a new innovation in architectural and acoustic design based on the "controlled reflections and diffusions of sound waves," discarding the "live and dead end" theory of acoustic design which has been widely used in the past.

A HIGH-QUALITY REPRODUCER FOR SMALL THEATRES

Messrs. Pfannenstiehl, Scriven and Hoge

Bell Telephone Laboratories

This sound reproducing system is intended particularly for use in small theatres of 600 seats or less. The sound pick-up part of this system consists of a sound head attachable to the various models of Simplex projectors. The film, after leaving the intermittent mechanism in the projector, passes through a chute in the sound head; then over a fly-wheel-controlled smooth roller where the sound track is scanned by an optical system; back to the hold-back sprocket in the projector and thence to the take-up magazine. This sound head contains no film drive sprocket mechanism.

This arrangement permits a simple and easily operated film drive control. A motor, belt-connected to the projector drive gearing and mounted on a bracket which maintains constant belt tension, is provided to drive the projector. Transformer-coupling is employed from the p. e. cell in the sound head to an amplifier arranged for wall mounting. This amplifier is contained in a cabinet which also includes a rectifier for supplying exciter lamp and stage speaker exciter current and a monitoring loud speaker. A control cabinet arranged for mounting on the wall in front of the projector contains a gain control and apparatus for switching from one machine to the other. This control cabinet is operable from either projector position.

RECENT IMPROVEMENTS IN THE VARIABLE WIDTH RECORDING SYSTEM

Barton Kreuzer

RCA Manufacturing Co., Inc.

This paper deals with the newly designed recording system. Many photographs are provided showing constituent parts and complete assemblies. Diagrams of various types of installations were shown. Discussion of the performance of the equipment was included and a typical re-recording lay-out was shown. Design movements resulting in higher quality and greater ease of operation were discussed.

ANALYSIS OF SOUND WAVES

Harry H. Hall

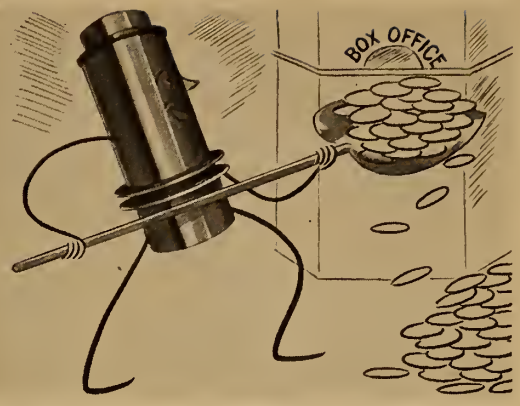
Cruft Laboratory, Harvard University

Most sounds consist of a spectrum of frequencies of various intensities. The distribution of these frequencies and intensities determine the quality of the sound. This spectrum may remain fairly constant in time or may go through rapid changes. Sound analysis is the process by which the various components of the spectrum are detected and measured. A complete analysis should furnish the frequency and amplitude of each component as well as its phase relative to the other components at a given instant of time. If the spectrum changes in time a complete analysis should be given at intervals throughout the duration of the sound, the lengths of the intervals being determined by the rate at which the spectrum is changing.

For purposes of analysis sounds may be grouped into three-classes: (1) sounds which may be maintained at constant frequency, constant intensity and unvarying quality for long enough to carry out the analysis; (2) sounds which are essentially transient in nature, and (3) sounds which may be maintained constant on the average but whose frequency, intensity and quality vary periodically within this time. The first two groups of sounds require different methods of analysis. The third group in certain instances may be analyzed by the methods used for class (1) while in others the

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"Iconoscopes and Kinescopes in Television" (Dr. V. K. Zworykin) is one of the articles by engineers of RCA and associated companies, covering developments in many branches of the radio field, in the first (July) issue of the new

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method used for class (2) may be necessary.

Sound analysis may be made to yield valuable information concerning the source of the sound, and the possibility of good transmission and reproduction. It also furnishes a measure of the quality of the sound. Methods of analysis and some results obtained are given. The analyzer built at the Cruft Laboratory is described and examples of analyses made with it are presented.

NEW ROTARY STABILIZER SOUNDHEAD

F. J. Loomis and E. W. Reynolds
RCA Manufacturing Co., Inc.

A new soundhead has been designed by RCA which further utilizes the inherent advantages of the rotary stabilizer method of reproduction. The soundhead is divided into two main parts, one of which carries all of the sound reproducing mechanism, and the second carries all of the power drive mechanism.

The sound parts—exciter lamp and mounting optical system, sound take-off drum, rotary stabilizer, collector lens, photocell, and transformer—are all mounted on one solid casting. This casting is vibration-cushioned from the remainder of the machine, which method of insulation is superior to the schemes previously used where each individual part was cushioned.

The power drive mechanism consists of a motor, a worm driving two worm gears, and a gear driving up to the projector. The motor is hub-mounted in rubber which insulates its torque vibrations from the remainder of the machine. The worm and gears run in a bath of oil. All parts are readily accessible with a minimum of effort. Highest grade chrome nickel steel and precision ball bearings are used throughout the drive mechanism.

All convenient features of previous soundheads are kept and several new ones added. Keyhold mounting slots are provided which permit easy and rapid assembly of the projector, and no shims are required. The soundhead is available in a wide variety of power supplies, and is adaptable for both Simplex and Powers projectors.

THE MOTION PICTURE SCREEN AS A LIGHTING PROBLEM

Matthew Luckiesh and Frank K. Moss
Research Laboratory, General Electric Co.

The motion picture on the screen is discussed as a visual task and its lighting and that of its environs is approached in the manner recommended by the authors for all lighting problems. After choosing the proper quality of light and having a screen brightness as great as is practicable, the problem becomes chiefly one of quality of lighting or distribution of brightness in the visual fields. Various aspects of visibility and psychophysiological effects of seeing are discussed. The problem is subdivided into two parts: (1) the attainment of maximal visibility within the central field (the motion picture on the screen) without regard to the surroundings, and (2) the illumination of the surroundings in such a manner as to produce maximal comfort and minimal loss in visibility. The problem is unraveled from the usual entanglement of physiologic optics, much of which is largely of academic interest rather than of practical importance. It is shown to be one of lighting to be guided by the same concepts, principles and knowledge embodied in the science of seeing as other lighting problems are.

Suggestions are made for practical studies of the possibilities of evolving the lighting of the motion picture screen and its environs from its present primitive stage of purely localized lighting which is undesirable.

SOURCE CONSTRUCTION AND LIGHT COLOR OF SOME INCANDESCENT LAMPS

R. E. Farnham and R. E. Worstell
General Electric Company

This paper first discusses the advantages of concentrating the source of gas-filled incandescent lamps. The various forms available and their application to optical systems and reflectors are shown. Data regarding the temperature (color and maximum) of the various types of lamps are presented and the similarity of the radiation of Mazda lamps to that of a Planckian radiator of suitable temperature is indicated. Curves showing the amount of light emitted at various wave lengths or colors for all lamps of interest to the motion picture industry are presented both in terms of equal visual output and equal wattage.

The amount of energy in the ultra-violet region and the effect of glass bulbs and lenses conclude the paper.

PRESENT TRENDS IN CARBON ARC APPLICATION TO THE MOTION PICTURE INDUSTRY

W. C. Kalb
National Carbon Company

The present trend in the application of the carbon arc to the needs of the motion picture industry is toward more extensive use of the high-intensity arc. This is true both in the theatre and in the studios.

The limitations of the low-intensity arc, both as to brilliancy and quality of light, are discussed and compared with like properties of the high-intensity arc. The needs of the small theatres for increased volume and improved quality of projection light having been met by the development of the A. C. high-intensity and Suprex type arcs; the demands of the largest theatres for still

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greater volume of projection light are now met by the new Super High-Intensity Arc.

The trends in projection lamp design as related to light on the screen are briefly discussed. The discussion of the progress of carbon arc lighting in studios covers the new White Flame Carbon Arc for broadside illumination, the new Sun Arcs and Rotary Spots designed to prevent interference with sound productions, and the application of the new Super High-Intensity Arc to background projection.

PROJECTION AND PROJECTORS

A. J. Holman

Nothing is more important to the industry than projection, yet producers, directors, and exhibitors show little interest in new projectors. The intermittent principle still is in universal use and false publicity pacifies the public. Lantern slide technique is described and its relation to motion pictures pointed out. How motion pictures have improved in 25 years and why: what further improvement can be hoped for.

Intermittent illumination and why it should be eliminated. Comparison of intermittent and continuous screen illumination; contrasts and their effects on seeing; persistence of vision, how it varies and its effects. Comparison tests on intermittent and continuous projectors with black-and-white and Technicolor film. Eyestrain and the industry's attitude past and future. Simple test to prove advantages of continuous screen image. Attitude of projector manufacturers and probable reasons. What continuous projection can do for the industry: cost of equipment and savings to theatre and to patrons. Industry invited to examine revolving lens wheel projector which can be made available to theatres in a few months.

The single lens wheel theatre model projector is described in detail: objective comprises one fixed component and one lens wheel which is only moving optical part; sphero-cylindrical condenser system; simplified film feeding mechanism with sound pick-up directly above picture aperture; improved fire shutter control and film movement stabilizer; accurate gear train reduced to four gears; new quick action take-up winds film solid on any reel. Optical system designed for additive three-color projection using optical economizer.

PHOTOELECTRIC EXPOSURE METERS

A. T. Williams

Weston Electrical Instrument Corp.

The paper deals with the theory of photoelectric exposure meters and its application in obtaining correct exposure. In addition to the elementary theory of exposure and exposure meters, calibration data were discussed in sufficient detail to enable the photographer or cinematographer to use the meter as a photographic tool with originality, thus avoiding the necessity of following stereotype instructions or the need of considerable experimentation. Applications of the meter for black-and-white as well as color photography were discussed.

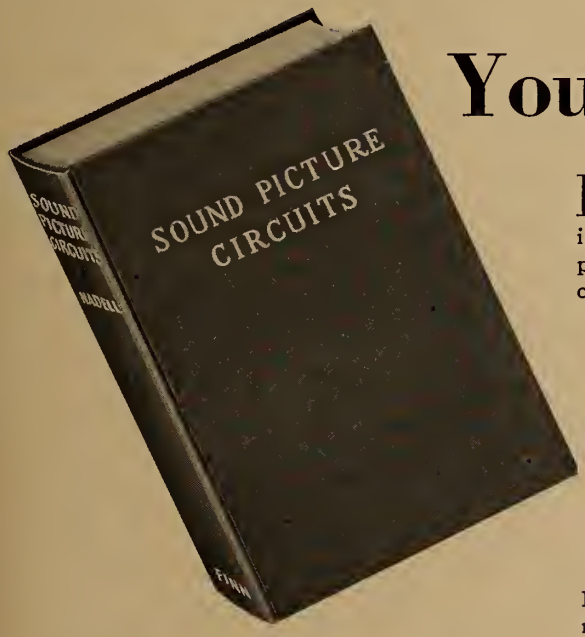
SOME PROPERTIES OF MOTION PICTURE FILM

A. H. Nuckolls and A. F. Matson

Underwriters' Laboratories, Chicago

The hazards in the handling or storage of cellulose nitrate motion picture film are due to the unusually low temperature of ignition of the film, its extremely rapid rate of combustion, and its ability of decomposing (exothermic) even in a restricted supply of air (oxygen) with the evolution of explosive and poisonous gases. Data and information in respect to these hazardous properties of cellulose nitrate film are given. The importance of complying with the Regulations of the National Board of Fire Underwriters cannot be overestimated in obtaining adequate provision for safe handling and storage of the film.

Film having a cellulose acetate-base was first submitted to the Laboratories about 20 years ago, and as the result of an extended investigation, the acetate-base film in form of ribbon for motion pictures was listed as



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slow-burning, the fire hazard being somewhat less than common newsprint paper in the same form and quantity. Data in respect to the hazardous properties of slow-burning cellulose acetate film are given, together with a brief description of tests conducted on slow-burning films at Underwriters' Laboratories.

THE 13.6 MM SUPER HIGH-INTENSITY CARBON

D. B. Joy
National Carbon Company

A new 13.6 mm. super high intensity carbon is described which will burn at currents as high as 190 amperes and which has a higher intrinsic brilliancy and a more uniform distribution of light across the crater face than the regular 13.6 mm. carbon rated at 120 to 130 amperes.

Tests comparing the light on a projection screen from this new carbon and the regular carbon show conclusively that the available light on the screen has been increased at least 30%. The arc lamp used with these carbons must be properly designed to take care of the increased current and carbon consumption.

THE BUSINESS SCREEN

W. F. Kruse
Bell & Howell Company

The use of motion pictures for advertising purposes has been with us for a number of years but it has only been in the last few years that the use of the business film has reached such outstanding proportions. A major portion of these films are now shown on 16 mm. sound equipment. Some idea as to the extent of the growth involved may be had by considering that the Chrysler Corp. allocated a *major portion* of its advertising allowance for the last two or three years for motion pictures. This is typical of many other organizations.

The paper describes some of the applications which have been made and the various groupings into which the several types of advertising pictures fall. A brief historical explanation is given as to why various types of films came into use and the reasons why these applications are likely to be extended. Specifications for the ideal sound projectors as outlined by advertisers are briefly given, together with a brief comparison as to what is available and how close it is to the ideal.

COPPER-OXIDE RECTIFIERS FOR MOTION PICTURE ARC SUPPLY

I. R. Smith
Westinghouse Electric & Mfg. Co.

The copper-oxide rectifier approaches in many ways the ideal rectifier, having a combination of characteristics found in no other rectifier. These include long life, no moving parts, silent operation and rugged construction. Although first applied in radio, since 1927 many industrial applications featuring reliability of operation have been made. These include thousands of units used in telephony, fire alarm systems, operation of time clocks, circuit-breakers and all types of contactors as well as many other applications.

This rectifier is a resistance device having negative temperature coefficient of resistance and a ratio of back-to-forward resistance of several thousand. Rectifiers can be built to any voltage and current output desired by paralleling discs or connecting in series as required.

Tests Indicate Indefinite Life

Ratings depend on heat-radiating ability. Heat dissipation is by convection cooling, using large radiating fins. Resistance characteristics undergo change with time, the extent depending on temperature and duty cycles. Standard ratings are based on the aged characteristics, not new. Nine-year-old life tests indicate indefinite rectifier life if properly applied. Fan cooling affords better heat dissipation, lowering unit temperatures permitting safe operation at higher outputs, and reducing unit size. Large outputs such as for arc supply can then be obtained from small rectifiers.

APPLICATION OF THE COPPER-OXIDE RECTIFIER TO MOTION PICTURE PROJECTION

C. E. Hamann
General Electric Company

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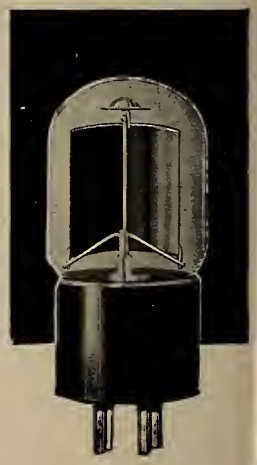
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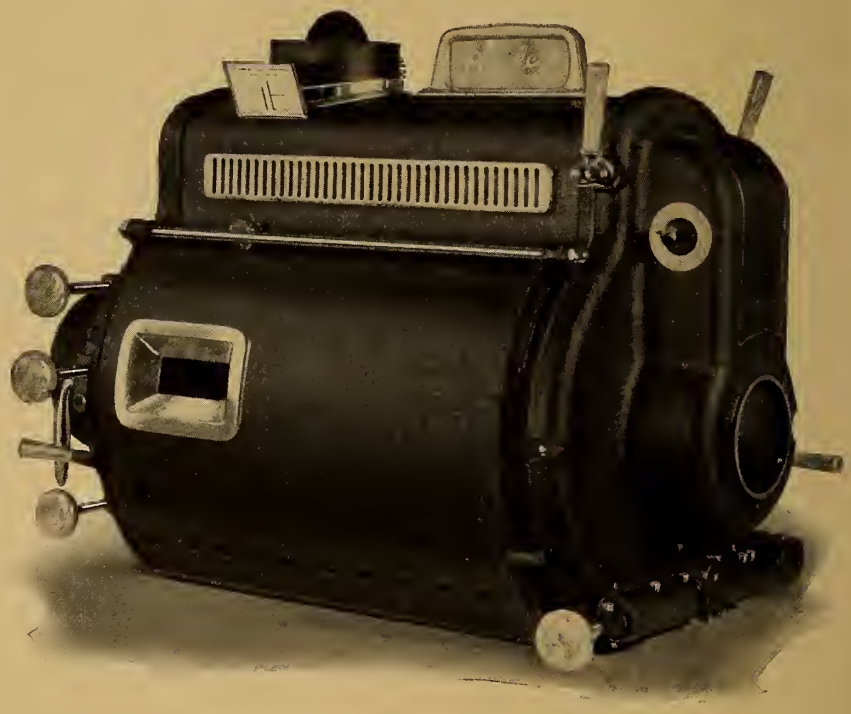
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International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

Volume 10 JUNE 1936 *Number 6*

Index and Monthly Chat 5

New Super H. I. Carbon, at 190 Amps., for Color Films and Larger Auditoriums .. 7
NATIONAL CARBON CO.

Color Requisites as Seen by a Cameraman and Painter 11
LEWIS W. PHYSIOC

H. Griffin Advancement a Personal and Craft Tribute 12

Step-By-Step Analysis of Sound Reproducing Equipment, XIX 14
WILSON N. DURHAM

More Data on Carbon Arc Power Supply 18
J. H. HERTNER
J. K. ELDERKIN

The Editorial Page 19

New Constitution, Longer Elective Terms Mark Serene I. A. 33rd Convention 20

The 6L6—A Radically New and More Efficient Beam Power Tube 22
AARON NADELL

News of the Month 23

Outdoor Television Shown; RCA Estimates 1½ Years to Home Sets 23

News Notes

Technical Hints

Miscellaneous Items

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MONTHLY CHAT

FIVE thousand miles of travel within the past month, with numerous stopovers here and there, deepens the impression we have long held, and often advertised herein, that the sum total of all other craft interests is approximately 1/64th as important as individual competency.

WHAT do *you* know about the new 6L6 beam power tube? All the dope on it appears in this issue. Add this job to the long list of other I. P. "firsts"—on color, on the Suprex arc, on television, on the servicing racket, and on other field developments too numerous to mention. It is no longer a question of whether I. P. will blanket any other medium; it's merely a question of how much ahead I. P. will be. More anent this topic elsewhere herein.

THE boys are already gabbing about a 10 mm. Suprex carbon. Fine. But the problem of more light of better quality might well be settled on the basis of present Suprex sizes with a little more probing into lamp design and optics. After this is done we can then consider whether Suprex carbons are best suited for color film reproduction. Mere size of carbons is a *detail* in the projection process. Oh, yes; we might have the screen cleaned once in a while, or even get a new one. The handkerchief trick is swell for putting the crushing convincer on the boss in this respect.

WHAT'S all this about magnification ratio of Suprex lamps? inquires a palpitating lamp manufacturer, who gently hints that I. P. practically "invented" this engrossing topic. Numerous letters from the field to I. P. on this subject will be baled and sent on to this seeker after knowledge. Theoretical data is of precious little use to the man behind the gun in holding a Suprex arc spot on the aperture or in effecting a fairly even screen light.

SCREEN manufacturers are once more suing one another for alleged infringment of patent rights. What better indication is needed that the equipment field is approaching normal?

TWO measures originally sponsored long ago by I. P. received official notice at the I. A. 33rd Convention: the servicing racket pursued by some companies, and the reluctance of these same companies to afford full information (schematics, etc.) to the projectionist. We didn't get an official credit line; but we're not bashful about taking it. You're welcome. Anything else?

MANY thanks to those who submitted data bearing on insurance rates for projectionists, the revision downward of which is one of the pressing concerns of I. P. at the moment.

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INTERNATIONAL PROJECTIONIST

VOLUME X NUMBER 6

JUNE 1936

New Super H-I Carbon, 140—190 Amps., Meets Demands of Color Films and Larger Auditoriums

DATA SUBMITTED BY THE ENGINEERING DEPT. OF NATIONAL CARBON COMPANY

THE recent announcement by National Carbon Co. of a new Super High-Intensity Carbon designed to burn at arc currents as high as 190 amperes is of particular interest to the larger theatres and to motion picture studios using background projection for process photography. The diameter of this new carbon, namely 13.6 millimeters, is the same as that of the present standard high-intensity carbon in common use. The core of the new carbon, however, is much larger than that of the regular carbon, the intrinsic brilliancy is higher and the distribution of light across the crater face is much more uniform.

Much Deeper Crater

The design and composition of the new carbon is such that it will give steady operation from 140 to 190 amperes at the arc. Compared with the regular 13.6 mm. carbon, the new super carbon increases the available light on the screen by 30 per cent.

The present standard 13.6 mm. high-intensity carbon, burning at 120 to 130 amperes at the arc in condenser type high-intensity lamps, has met and will continue to meet the requirements of many theatres. The tendency in some of the larger theatres toward a higher level of general theatre illumination, increased size of auditoriums and the anticipation of a more general use of colored film, has created a demand for a more powerful light source for projection. The greater amount of light at high currents from the new super high-intensity 13.6 mm. carbon and the wide range of currents through which operation is satisfactory show that the carbon manufacturer is alive to the needs of the industry and is diligently working to meet them.

As mentioned previously, the new super high-intensity carbon is designed to operate at 140 to 190 amperes. At the lower current the crater is comparatively shallow, but at the higher currents it is considerably deeper than that of the present standard high-intensity carbon. In order to use these new carbons the projection lamp must be properly designed to take care of the increased current and carbon consumption.

Table A shows the comparative rates of consumption of the new super and the regular high-intensity carbons.

From the shapes of the curves in Fig. 1 showing the intrinsic brilliancy distribution across the crater face of both the super and the regular carbons, it can be seen that the intrinsic brilliancy of the super carbon at 180 am-

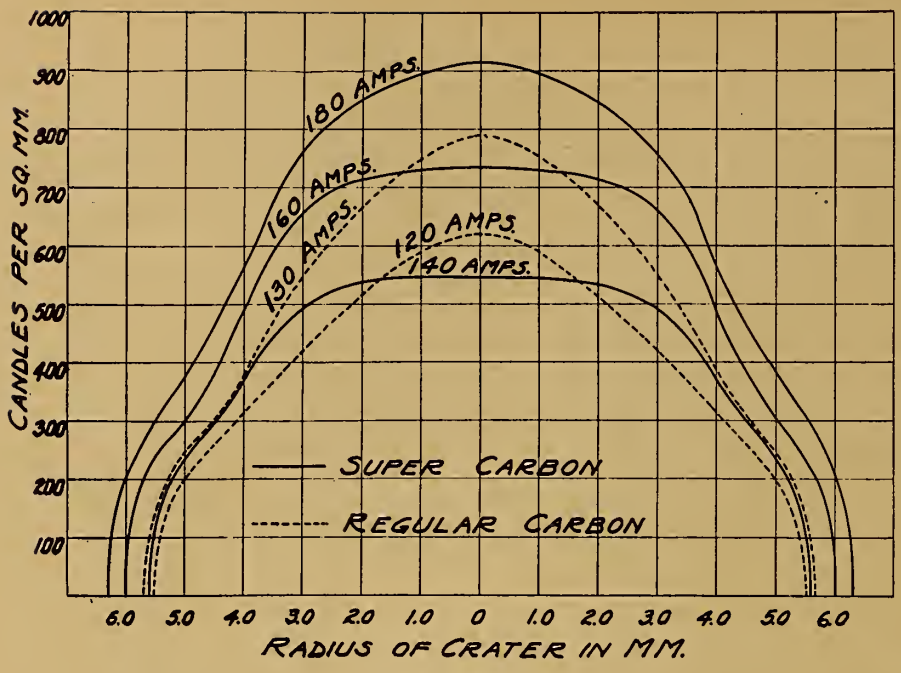


FIGURE 1

Regular and Super 13.6 mm. high-intensity carbons intrinsic brilliancy distribution across the crater face

peres is noticeably higher than the regular carbon at 130 amperes. There is also less tapering off of crater brilliancy in the new super carbon from the center to the sides of the crater at all current values. This flatness of the intrinsic brilliancy curve is especially accentuated at the lower current densities in the new super carbon. It will also be noticed that at 160 amperes the intrinsic brilliancy at the center of the crater of the new super carbon is less than that of the regular carbon at 130 amperes but it is considerably higher at the sides of the crater.

The crater depth of the new carbons increases with the increase in current. The effectiveness of the larger core in the new super carbon and the increased operating current is evident from the curves in Fig. 1, which show that the intrinsic brilliancy of the new carbons is higher at the high currents and more uniformly distributed across the crater face than in the case of the regular 13.6 mm. carbon.

Brighter, More Uniform Light

A comparison of a magnified image of the crater face of the regular and of the super carbon further emphasizes the significance of this difference in the intrinsic brilliancy distribution. The light from the regular carbon shows a rather gradual change in color from the center to the edge of the crater where the incandescent shell is the predominating light-giving material. This color change is much less noticeable in the image of the super carbon because the larger core allows the incandescent gases to fill the crater more completely and to serve as the principal source of light.

The intrinsic brilliancy curves also indicate that the new super carbon, when operated at its rated current, will not only give a higher light but a more uniform light on the projection screen than the present standard carbon. These facts have been substantiated by tests which show that the super carbon will give at least 30 per cent more light than the regular carbon with the same screen light distribution. In addition it is possible, with this new carbon, to build up the light at the sides and corners of the screen.

In addition to its adaptability as a high-powered light source for theatre projection, the new super high-intensity carbon will also give the additional light needed for the more successful projection of backgrounds for process photography in the motion picture studios. The requirements of this process necessitate a light source powerful enough to project a background scene through a translucent screen. This background scene is rephotographed with the objects and action in the foreground thereby welding the whole into the final composite scene which becomes a part of the production. Besides the power required for overcoming the light loss through the translucent screen, the range of intensity of the new super high-intensity arc is broad enough to compensate for the difference in density of the films being projected and the more uniform distribution of the intrinsic brilliancy across the crater face will tend to give an improvement in the light distribution on the screen.

In order to utilize this new carbon to the best advantage the projection lamp must be capable of standing the high currents, and the feeding mechanism must feed the carbons uniformly at the consumption rates indicated in Table A.

Some Practical Hints On Volume Controls

Volume controls, points out the engineering department of Clarostat Mfg. Co., are furnished with three terminals permitting their use as rheostats or potentiometers. When used as potentiometers, all three terminals are employed. When used as rheostats, the center or contact terminal, and either the right or left terminal, are employed, depending on whether resistance is to increase or decrease with clockwise rotation of knob.

It is highly important when using tapered controls that terminals be connected into the circuits as shown in wiring diagrams. Otherwise, due to characteristics of taper recommended, efficient control will not be obtained. The accepted method of connecting volume controls is such as to provide minimum volume at extreme counter-clockwise rotation of the moving arm.

Pre-Testing Recommended

It is well to test the operation of a volume or tone control before mounting and soldering the connections. When soldering, especially the composition type, never allow flux or solder to run down terminals into the case, since such materials coming into contact with the resistance element will cause the control to become noisy. Also, never solder any connection to metal cover, for the extreme heat dissipated through contact with hot soldering iron will tend to damage the control.

TABLE A

Consumption of Regular and Super 13.6 MM. Carbons at Same Arc Setting

Carbon	Current	Voltage	Consumption in Inches per Hour
Regular 13.6 mm.	120	64	11.3
Regular 13.6 mm.	130	68	15.5
Super 13.6 mm.	140	60	12.6
Super 13.6 mm.	160	66	18.0
Super 13.6 mm.	180	72	25.5

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Color Film Requisites as Seen By a Cameraman and Painter

By LEWIS W. PHYSIOC
TECHNICAL EDITOR, INTERNATIONAL PHOTOGRAPHER, HOLLYWOOD, CALIF.

I. P. has frequently deplored the profusion of language by color film workers anent "art forms" and "warm color hues" and "psychológical reactions," to the almost total exclusion of practical data on the making and showing of such productions, and it has repeatedly voiced its preference for the well-done black-and-white picture over most of the color subjects released to date.

Lewis W. Physioc, standout technical man among our West Coast cameramen colleagues, and himself a fine worker in oils, is afflicted with no such delusions as haunt the majority of color film enthusiasts. His accompanying article on color is a penetrating analysis of the problems confronting this baby art and advances several extremely worth while suggestions for effecting improvement.—*Editor.*

THE writer frequently has been asked to give his opinions on the important subject of color photography. Up to the present time he has refrained—for several reasons. First, because he believes that opinions are of less benefit than axiomatic conclusions. Second, an expression of opinions entails the use of that old personal pronoun so generally obnoxious. More dreadful, still, he trembles at the thought of opposing the opinions of those who are recognized as authorities. This is admittedly the case as regards the present subject.

Many of my color-minded friends have suspected me of lacking interest in color photography. This is true only in the matter of the two-color processes. This confession does not mean that I lack appreciation for the efforts of those who have so patiently and courageously experimented in the application of color to the motion pictures: I concede many striking effects in those experiments. It means, merely, that one who has enjoyed the delights of the unlimited range of the painter's palette could not fully be satisfied with the renderings of a two-color system.

I have been a color-photo enthusiast from the first introduction of the Autochrome, and other color plates. I still pour over the pages of the National Geographic Magazine, whose particular appeal is in those color plates. They have taught me one outstanding fact, *i.e.*, the success of each subject depends upon the ability of the *artist* behind the camera: it is *choice* of the subject. Even after the completion of a series, there still is another choice to determine which among the group fully satisfies the demands of the artistic taste for color. One need but look into the rack of discards to realize this fact.

Vital Questions Posed

This suggests a string of questions, opinions and stock phrases we so frequently hear regarding color photography—"pastel shades"; "colors as seen in Nature"; "gaudy colors that tire the eyes"; "art directors and color theorists running wild," and the like.

Let us study these questions.

It would seem that the very thought of color photography would encourage the employment of the trained artist (or color expert); but the general criticism and comments tend to show that color-pictures appeal to the vast public and not to the minor group of art enthusiasts. This, in turn, throws the subject into an all-time controversial field. Many works of art that have enjoyed a wide popular approval have been less favored by academicians and art critics; and, conversely, those works more loudly acclaimed by the critics have been coldly accepted by the public.

Then arises the question: What is art? Is it something that appeals to the great mass of lay minds, or that which is approved by the trained artist or critic, or is it represented only in those rare productions that satisfy not only the masses but elicits, also, the praise of the critic? If this latter clause suggests the answer, we, indeed, set a high mark for color photography.

We frequently hear the comment: color pictures will never be a success until they can produce those soft, "pastel shades." This term "pastel shades" means nothing to the artist. His every color scheme is the result of some design, some instinctive response he cannot define. Every time he takes up his palette those pigments upon it yield to a variety of tints that bear no name except in the abstract tongue of that artistic instinct. Those tints may range from a series of delicate, high-key hues of soft grays (pastels, if you wish) to bold, rich, positive tones. Has either any value over the other? They are both the result of that instinctive direction.

The term "pastel" has been popularized by the sheer beauty of that particular medium—the velvety surface and softness of line and texture. Unlike oils or wash, pastels are not mixed on the palette from the primaries; they are made in series of hues, ranging from the full value of the primary to its most delicate suggestions. The artist conveniently selects the hue most nearly



Excellent example of how background projection process is utilized in modern-day motion picture production. Increasing use of process is anticipated. Photo by courtesy of "International Photographer".

approaching the dictates of his instinct. But these hues have been mixed by the *trained expert* and are judiciously tempered with delicate grays to relieve the garish effects likely to result from tints mixed by students that do not fully understand color harmony.

I do not believe there is any pair of eyes that tires of a pretty color scheme, certainly not mine. On the contrary, my eyes refuse anything that is not agreeable in the matter of color. I am looking for color in everything, at all times. I readily admit, however, that it is easy to tire of a succession of effects rendered by the raw primaries or the two complements unrelieved by secondary and tertiary tints as furnished in the full spectrum. Hence my lack of interest in a two-color process.

Colors As Seen In Nature

The producers have been criticized for an unnatural extravagance in color schemes. This is merely a prejudicial hangover from the two-color systems that rendered a preponderance of the two complements employed—red and green or orange and blue.

In considering this criticism we cannot refrain from a defense of those who have striven so earnestly in the two-color efforts, particularly Mrs. Natalie Kalmus who grew up with color pictures. Mrs. Kalmus has had considerable experience, and there is little doubt that the best results of the Technicolor two-color process were due to her taste and training in color harmony, plus her knowledge of the limits of any two-color system. The best proof of this is their persistent efforts for a three-color process.

The other systems, like Multicolor, and particularly the additive systems, are subject to the same criticism, but claim the same defense, *the limits of any two-color system.* However, we hope Mrs. Kalmus and the other experts will not be too much influenced by the demands for naturalness—for many reasons.

I have no fanatical belief that everything in nature is beautiful. Dame Nature is a lady of many moods, otherwise she would not be so intriguing. Art is dependent upon catching her in her most fascinating moods. John Ruskin said something to the effect that if the artist always painted Nature as he saw her he would sell few of his pictures. And the portait painter and photographer will tell you that if they rendered their patrons "true to life" they would enjoy few commissions.

Artists have gone sketching, and wandered for days without finding a fit subject for reproducing. Returning, disconsolate, one may come upon one of those rejected subjects and become startled into enthusiasm. The commonplace scene now appears under different lighting and atmospheric conditions and is transformed into an inspiring subject. But even now, the artist feels impelled to alter the drawing here and there, and modify certain tones, generally idealizing an already attractive subject.

To be sure, Nature is sometimes lavish in her offerings, and there are occasions when the artist finds it difficult to find anything on his palette to match the brilliance of the color scheme before him. Here lies the fascination of still-life subjects, such as flowers and fruit. But I have never heard of anyone becoming tired of looking at flowers, Nature's "gaudiest" color display.

This flickleness of Nature seems to suggest that if the producers of color pictures go out to Nature and shoot from morning till night, without the aid and guidance of the artist, they will meet with many disappointments. And any process that does not permit of the artist's aid will not be a permanent success. The *true artist* seldom "runs wild."

When I first beheld one of the "Silly Symphonies" I was thrilled—my emo-

(*Continued on page* 30)

Election of H. Griffin as V.-P. of International Projector Corp. a Personal and Craft Tribute

THE motion picture firmament is studded with ex-technician "stars" who developed into top-flight executives —cameramen who became production chiefs or projectionists who attained direction of theatre circuits or large-scale equipment manufacturing enterprises. Some projectionists even succeeded in getting themselves elected to Congress—however mortifying it may be to admit it.

An outstanding example of achievement by a practical projectionist is Herbert Griffin, recently elected vice-president of International Projector Corp., the products of which are known throughout the world wherever motion pictures are shown. The name Herbert Griffin invariably, inevitably is telescoped into "Griff"; it always has been and undoubtedly always will be.

Beginning in 1907 Griff worked as a projectionist, at which time he became an I. A. man, which he still is. His first connection with the equipment manufacturing branch of the industry was with the Standard Motion Picture Projector Co. Later he joined the Nicholas Power Co.; and when this firm combined with the Precision Machine Co. to form the International Projector Corp., Griff was named general sales manager.

Griff was a member of the old Auxiliary Local 35, predecessor of Local 306, and a charter member of the latter organization.

A Varied Experience

During succeeding years Griff saw not a little of this world. He has penetrated into practically every corner of the U. S., of course, and during the War his motion picture activities took him throughout Europe and included a sojourn of some months in Vladivostok, eastern Russian extremity in Asia. Wartime exigencies added immeasurably to Griff's store of knowledge of practical projection, the fruits of which he applied subsequently to many knotty problems.



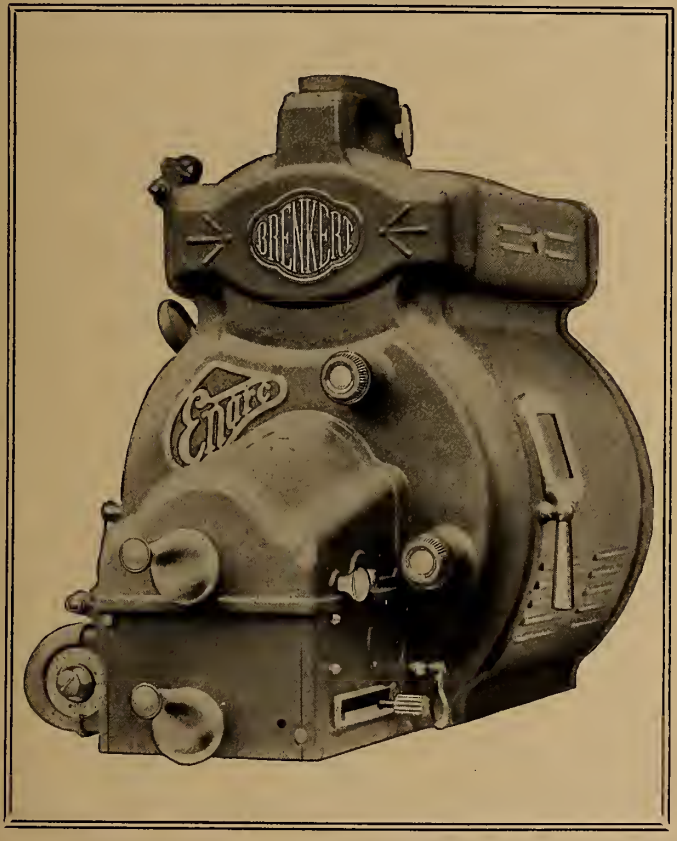
Herbert Griffin

The phrase "general sales manager," a post which Griff has held for 15 years, blankets other activities, including many hours of work on engineering and patent problems. Griff is a member of the Board of Governors, as well as many important committees, of the S.M.P.E., the proceedings of which attest in full-some measure his authoritative rating in all projection matters.

With all his scientific attainments and knowledge of the art of projection, from both the manufacturing and exhibition standpoints, Griff remains and is considered throughout America as still being "just one of the boys"—an appelation of which Griff, above all other distinctions, is inordinately proud.

Griff's advancement to his present important post with the International Projector Corp. is an occurrence of which both he and the craft which he represents may well be proud, the more so because it is a post won by unremitting effort and pronounced native ability. No one has more rightfully earned a high position in the industry than has Griff, and I. P. is proud to make public acknowledgment of that fact.—J. J. F.

PROTECTION TO THE PROJECTIONIST



. . . WITH BRENKERT ENARC, the only projection lamp, using copper-coated carbons, that completely prevents the arc fumes reaching the projection room. The correctly ventilated lamp house, with no vent openings above the line of the arc except the chimney, and the close fitting doors, insure the arc fumes escaping *only* through the chimney.

•

When air suction type rear shutter is used on projector, a front glass cone is supplied on the BRENKERT ENARC to prevent arc fumes being drawn through the nose of the lamp.

•

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Detroit, Michigan, U.S.A.

Step-By-Step Analysis of Sound Reproducing Equipment

By WILSON N. DURHAM*

XIX. Lafayette 400-A Amplifier

THE amplifier diagrammed in Fig. 1 presents several modern features not found in amplifiers previously analyzed in these pages. Among these are the use of tubes of recent type, including the 6L6 beam power tubes which, in spite of their small size and low cost, develop an output power of 40 watts per pair! The electronic equalizer circuit used in this amplifier is distinctive, and the incorporation of a separate grid bias rectifier tube, contributing greatly to stability of operation, is decidedly rare in theatre equipment.

Five pairs of terminals are provided for external connections. The two in the extreme upper corners of the diagram are for the p.e. cell input leads. At the right-hand side, half-way down the drawing, are the output terminals to the speakers. The a.c. input is wired to the pair at the left center. The function of the terminals shown at the bottom, just beside the 82 rectifier tube, will be explained subsequently. We will consider first the power supplies.

The Power Circuits

The a.c. line enters at left-center of the diagram and runs down and right, completing its circuit through the primary of the power transformer. The main line switch is indicated by a cross-mark within a circle, in series with the upper wire of this circuit. Just to the right of the switch a fuse is mounted between two fuse clips, and a third fuse clip, unused, is also provided. It will be noted that there are three connections to the power transformer primary. In the circuit as drawn connection is made, through the fuse, to the maximum number of primary turns, compensating for high line voltage. If the a.c. line voltage is low, the fuse is clipped between the left-hand and center clips instead of in its present position, thereby making operative a smaller number of primary turns and compensating for low line voltage.

There are five secondary windings. The third of these is center-tapped, and its terminals are marked "6.3 V." These terminals supply heater current to the amplifying tubes, but neither the connecting wires nor the heaters of the tubes themselves are shown, being omitted to avoid complication. As is standard practice, the secondary terminals just referred to are wired to the heaters of the tubes through twisted pairs of conductors. Since the heaters are insulated from the tube emitters or cathodes, and no other connection of any kind is made to them, there is no need for including them in the drawing.

The second and fourth secondary windings heat the filaments of the two rectifier tubes, the 82 and the 83. The left-hand secondary provides grid bias d.c. through the 82 rectifier, while the extreme right-hand secondary supplies plate power through the 83.

Plate Power Circuits

The 83 tube may be considered a source of d.c., of which the center tap of the plate transformer is the negative terminal, and the filament of the 83 the positive terminal. Tracing from positive to negative, the "B" line runs upward from the 83 filament and right through the two filter chokes. The two 8-microfarad condensers shown just below them are part of the filter. From the right-hand choke the circuit continues upward through the 2,500-ohm resistor to the screen grids of the 6L6 tubes, thence to the cathodes of those tubes, and to the ground.

Returning to the center tap of the plate secondary that supplies the 83 tube, trace to the right, up, left and down to No. 1 terminal of the terminal strip at the bottom center of the drawing. Out through that terminal and in again at No. 2 of the same strip to the ground, completing this circuit provided the two terminals referred to are connected together through an external switch. The external switch is opened, in dual-channel operation, when this amplifier is standing by. Under those circumstances the tubes are heated, but plate power is not applied until the external switch is thrown to put this amplifier into operation.

The circuit just traced supplies screen grid voltage to the 6L6 tubes, the plate voltage to which will be traced hereafter. Plate voltage to the other amplifying tubes, and to the photocells, is applied through a wire that branches off to leftward just above the 2500-ohm resistor already mentioned. Following that wire to the left a short distance, a line is seen leading upward through the primary of a coupling transformer to the plate of the 42 driver tube. This tube acts as a triode, its screen grid being wired in parallel to its plate. The cathode returns directly to the ground.

Instead of branching upward to the plate of the 42, continue leftward past another 8-microfarad filter condenser, and up through two 100,000-ohm resistors (in this drawing M means 1,000) to the plate of the 76. From the cathode trace down through the 3,000-ohm bias resistor, and left to ground. Instead of branching upward to the plate of the 76, continue left through another resistor of 100,000-ohms to a four-way junction.

[For convenience, this four-way junction will from now on be considered the positive terminal of the B supply of this amplifier, just as ground, which is connected through the external switch to the center tap of the B supply secondary of the power transformer, is considered negative.]

From the four-way junction trace up through two 100,000-ohm resistors to the plate of the right-hand 6C6 tube; to the cathode of that tube; down through the 1,000-ohm grid bias resistor, and left and down to ground. From the four-way junction trace up through 100,000-ohms and then left and up through 500,000-ohms to the screen grid of the same 6C6, and from the cathode of that tube to ground, as before.

Returning again to the same four-way junction, trace down through 100,000-ohms, left, up through 25,000-ohms and through 100,000-ohms to the plate of the left-hand 6C6. From the cathode of that tube through the 1,000-ohm grid bias resistor to ground. From the four-way junction trace down through 100,000 ohms, left as far as possible through 500,000 ohms, and up, right, up, right and up to the screen grid of the 6C6. Thence to cathode and ground as before.

The four-way junction connects to the

*Consulting Sound Engineer, Wholesale Radio Service Company.

left-hand side of a 100,000-ohm resistor, drawn horizontally. From the right-hand side of that resistor a wire leads downward, carrying the plate supply to the photocells, and may be followed down, left across the drawing, and up through 35,000 ohms to a point of junction from which two potentiometers branch leftward. The left-hand sides of those potentiometers return to ground. Any desired portion of the voltage-drop across them is tapped, by means of the sliding contacts, to supply voltage to the anodes of the p.e. cells. By means of a switch shown just above, a voltmeter can be connected between either slider and ground, and will therefore read the voltage applied to either cell. Adjustment of the potentiometers is made by reference to this meter.

From the right-hand slider the line leads up through 1 megohm, through 3 megohms, and right to the output terminals supplying cell No. 2. The return from the cathode of that cell is connected to the shielding of the cable (in this drawing, all broken lines represent shielding) which is grounded—trace along the upper shield line left across the top of the drawing, and then up, left and down around the heavier shielding to the ground connection.

From the left-hand potentiometer slider the circuit to the other cell runs up and left to the positive output terminal to p.e. cell No. 1. The corresponding negative terminal is connected to the shielding, and therefore to ground.

One B supply circuit still is untraced—that which supplies the plates of the 6L6 output tubes. It is tapped off between the first and second filter chokes shown just above the 83 rectifier, and runs up, right and up to the center tap of the output transformer primary. From the ends of that winding to the plates of the tubes, and from the cathodes of those tubes to ground.

The plate current through the 6L6 tubes will vary considerably at high volume levels, but being thus dissociated from the plate supply to the other tubes and to the p.e. cells will not cause material variation in their plate voltages. Fluctuations that would otherwise result, in the supply to those tubes, are ironed out by the right-hand choke coil and the condensers of the filter system.

Grid Bias Supply

The control grid of the left-hand 6C6 is the grid shown next to cathode, and may be traced to ground as follows: left, up, right, up, right, down through a 5-megohm grid leak to shielding or ground. The cathode of the same tube may be traced to ground through the 1,000-ohm resistor shown just below it. The plate current of the tube flows through that resistor, and therefore a potential difference must exist between its terminals, cathode being positive and ground negative. Since the grid is connected to ground through a grid leak in which no d.c. flows, cathode will be similarly positive with respect to grid; or, expressed another way, grid will be negative with respect to cathode by the extent of the voltage-drop existing across the 1,000-ohm resistor.

The plate current flowing through this grid bias resistor will vary, despite the by-pass condenser of 25 microfarads, when sound is reproduced, creating a corresponding variation in the grid bias of the tube. At the output level at which this tube operates, however, the effect is unimportant. In the case of the power tubes of the amplifier, the same method of obtaining grid bias cannot be used, because at high volume levels a bias so obtained would fluctuate disastrously.

The right-hand 6C6 and the 76 are biased in the manner just traced. From the control grid of the right-hand 6C6 trace down through 500,000 ohms to shielding or ground. From the cathode of the same tube trace down through 1,000 ohms and left to ground. The voltage-drop existing across this 1,000

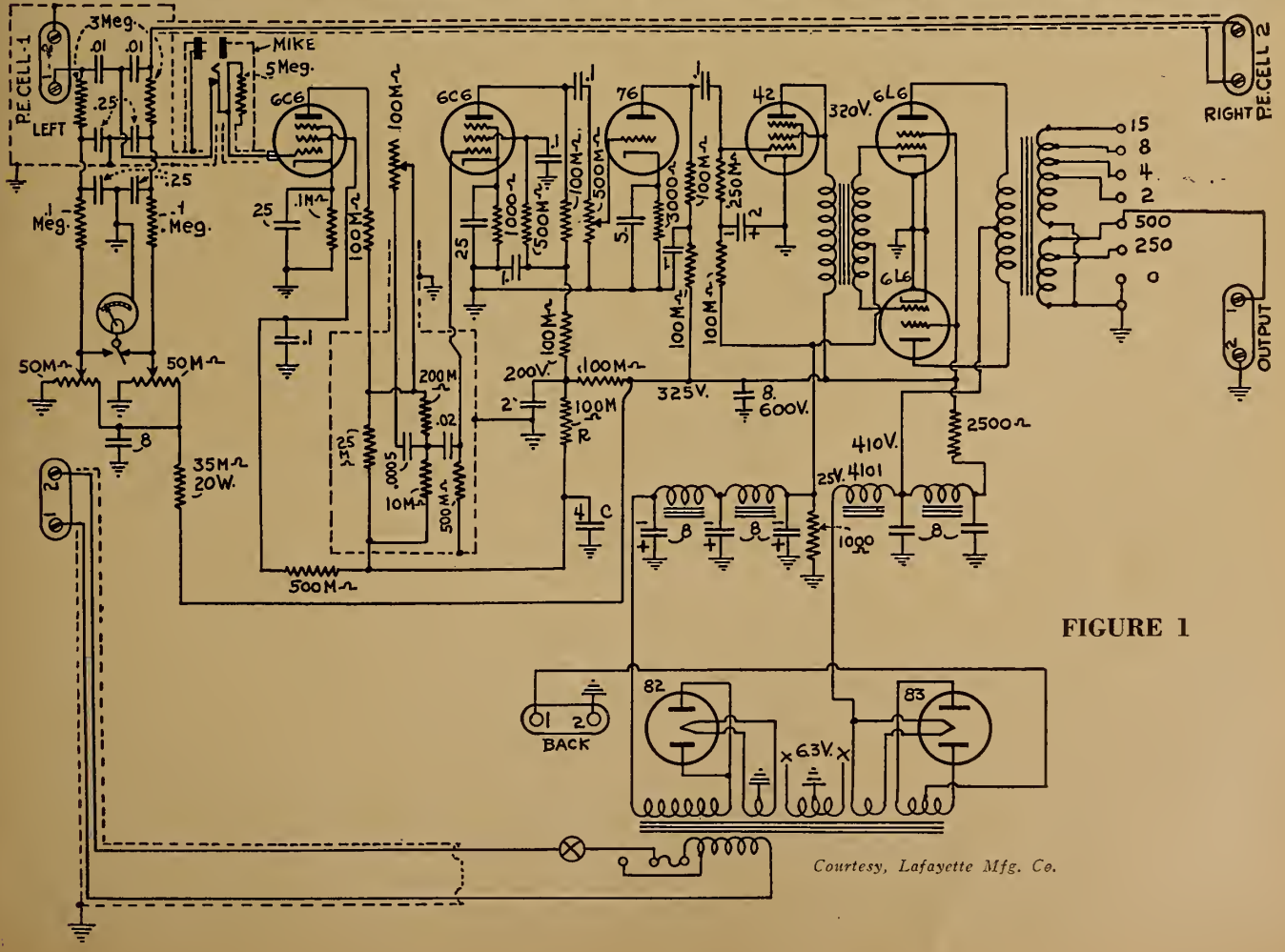


FIGURE 1

Courtesy, Lafayette Mfg. Co.

ohm-resistor is the measure of the grid bias of that tube.

From the grid of the 76 trace down to the slider of a 500,000-ohm potentiometer, down through the resistance and left to ground. From the cathode of the same tube the plate current flows through 3,000 ohms, and left to ground.

In both these tubes variations in plate current corresponding to the sound input will be accompanied by a proportionate, though unimportant, fluctuation of grid bias. Grid bias for the 42 and the 6L6 tubes is drawn from a separate source, the 82 rectifier, and is entirely independent of plate current.

The 82, although it has two plates, is connected as a half-wave rectifier, the plates being paralleled to one end of their power transformer secondary. From the other end, which must be negative when current is flowing through the space of the 82, trace (from negative to positive) up, right through the filter, and down through 1,000 ohms to ground; thence to the center tap of the 82 filament supply secondary, to the filament, to both plates (when they are positive) and to the right-hand end of the plate secondary, completing the circuit. The load upon this circuit is the 1,000-ohm bias resistor, the upper end of which is negative with respect to ground. The grids of the 42 and of the 6L6 tubes are readily traced to the upper or negative side of that resistor. The cathodes of those tubes being grounded, their grids are negative in comparison with their respective cathodes.

An important feature of this bias circuit is low value of the load resistor, only 1,000 ohms. It is an inherent and desired feature of the amplifier that speech current at high volume levels, applied to the grids of the 42 and of the 6L6's, shall during part of each cycle completely overcome the grid bias and "swing" the grids positive. When this takes place the grids attract electrons emitted by the cathodes, and there is a flow of grid current which returns to cathode, or ground, through the 1,000-ohm resistor that provides the permanent grid bias. If this resistor were of higher value, the voltage-drop across it (current times resistance) would vary markedly at high volume, with correspondingly unstable operation. The relatively low resistance of 1,000 ohms insures constancy of amplifier characteristics regardless of the volume level.

There are three sources of sound input; two connection blocks for the two photoelectric cells, and the microphone jack that may be used for announcements, phonograph, etc. Considering No. 1 cell, when light admitted to that cell is varied by a moving sound track its anode and cathode may be regarded as the poles of a source of fluctuating d.c.—the speech component added to its current by virtue of its response to modulated illumination.

The Speech Circuits

The 5-megohm coupling resistor, in the upper left-hand corner, constitutes the load to which this fluctuating d.c. is applied; the upper end of that resistor connecting to the anode of the cell, while its lower end returns to the cell's cathode through the .25 condenser. shown just right of and below the 3-megohm resistor, and through ground. That condenser provides a path for fluctuating d.c. which, however, could also return to ground through the source of B supply. As this would be undesirable, as explained hereafter, the alternative path of the .25 microfarad condenser is provided and a 1-megohm resistor is placed in series with the source of B power. For d.c. fluctuations of speech frequency the condenser (paralleled by another of .25 microfarads shown just below it) offers the path of less resistance.

A second load is placed in parallel to the 3-megohm coupling resistor, as follows: from the upper end of that resistor right through the .01 coupling condenser, and down, right, up to the microphone jack and through the contacts of that jack to the upper end of the 5-megohm grid leak which (for fluctuating d.c.) is thus effectively paralleled to the upper end of the 3-megohm coupling resistor. The lower ends of both resistors are also effectively in parallel, both being grounded. The lower end of the grid leak returns to ground shielding directly, and the lower end of the 3-megohm resistor through the paralleled .25 condensers. Hence, part of the fluctuating d.c. originating in No. 1 p.e. cell flows through the 5-megohm grid leak. The corresponding fluctuation in potential difference across that grid leak modifies the grid bias of the first 6C6 tube.

The input arrangements from No. 2 photocell are precisely similar. Both cells are connected at all times, except as either may be isolated by an external switching panel provided in some systems using this amplifier. When there is no switching panel, one of the two cells is always dark and delivers no speech current.

If a plug be inserted into the microphone jack, the contacts shown in the drawing are opened. The photocell circuits are opened, and only the microphone input will be operative. The plug does not make contact with the left-hand prong but with the long right-hand prong and the shield, and the speech input derived through it is thus connected directly across the grid leak.

When the bias of the control grid of the left-hand 6C6 fluctuates, the plate and cathode of that tube may be regarded as the poles of a generator of fluctuating d.c. of greater amplitude. Trace from the cathode down through the bias resistor to ground. Trace from the plate down through the plate load, 100,000 ohms and 25,000 ohms; thence right, up, right and down, through Condenser C, 4 microfarads, to ground. From the top plate of Condenser C there is a parallel path to ground through the source of B supply, but the inclusion of Resistor R, 100,000 ohms, and of the other 100,000-ohm resistor shown just right of the four-way junction, make this a path of very high relative impedance so far as fluctuating d.c. is concerned, and the return of speech current through the source of B supply is effectively discouraged.

The Electronic Equalizer

The 25,000-ohm resistor just mentioned as forming part of the plate load across the 6C6 tube is paralleled by a branch path. From the upper end of that resistor trace right and down through 200,000 ohms, down through 10,000 ohms, and left and up to the lower end of the 25,000-ohm resistor. Part of the speech current of the 6C6 flows through this parallel path. The fluctuating potential difference across the 10,000-ohm resistor is applied to the grid and cathode of the next tube following, the right-hand 6C6. From the upper end of 10,000 ohms, trace right through the .02 coupling condenser and up to grid. From the lower end of 10,000 ohms left, down, right, up, right, down through 4 microfarads to ground; from the cathode

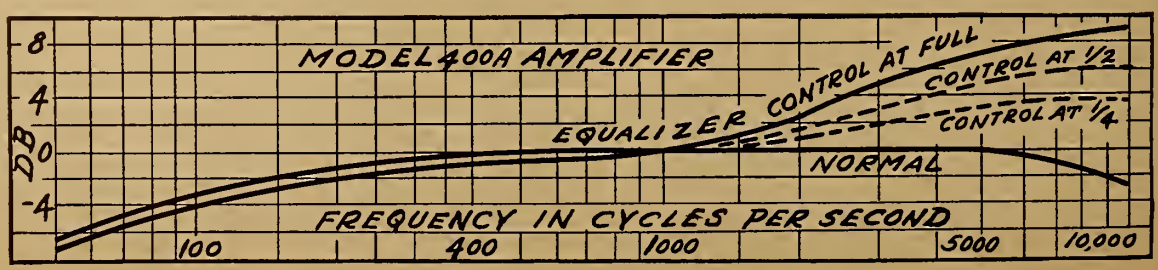


FIGURE 2

Courtesy of Lafayette Mfg. Co.

of the right-hand 6C6 through 25 microfarads to ground.

The 10,000-ohm resistor thus acts as the source of the fluctuating d.c. which modifies the grid bias of the right-hand 6C6 tube in accordance with the speech frequency of the input to the amplifier. That resistor, however, is in series with the 200,000-ohm resistor shown just above it, and (all other considerations eliminated) its voltage-drop would be 10/210 of the total voltage-drop across both. But other considerations can be made to intervene.

The 200,000-ohm unit is bridged by a condenser, and the impedance of a condenser varies with frequency. The ratio, 10/210, therefore varies in accordance with sound frequency. From the lower end of 200,000 ohms trace left through .0005 microfarads, up through a 100,000-ohm potentiometer, and down to the upper end of 200,000 ohms. The setting of this potentiometer varies the effect of the condenser, which, by lowering the slider all the way, can be placed completely in parallel with 200,000 ohms or, by moving the slider all the way up, can be practically open-circuited.

By using the potentiometer to make the condenser ineffective the ratio 10/210 can be maintained practically constant at all sound frequencies. By cutting down the potentiometer setting the condenser can be made progressively more effective, and the ratio 10/210 will then vary widely with frequency. The range of sound response curves that can be obtained with this Lafayette equalizer is shown in Fig. 2.

Speech Circuits After Equalizer

Considering the plate and cathode of the second 6C6 as the poles of a generator supplying fluctuating d.c. of still greater amplitude, trace down through the 100,000-ohm plate load resistor, left through the 1-microfarad coupling condenser, and left and up to cathode through the 25-mfd., by-pass condenser. The 100,000-ohm resistor leading upward from the four-way junction constitutes a high impedance introduced into the path of return through the source of B supply.

The fluctuating d.c. flowing through the plate load is provided with a parallel path from the upper end of that load up, left through the .1 coupling condenser, and down through the 500,000-ohm potentiometer, left and up to cathode through 25-mfd.

Any desired portion of the voltage drop developed across the ½-megohm potentiometer can be connected across grid and cathode of the 76. From the slider directly to grid. From the lower end of the resistance right and up through 5 mfd. to cathode. The potentiometer is the volume control of this amplifier.

From the plate of the 76 trace down through 100,000 ohms, thence left and down through .1 microfarad, and left and up to cathode through the by-pass condenser, 5 mfd. Return through the plate supply is discouraged by the 100,000-ohm resistor running downward from the lower end of the 100,000-ohm plate load.

If the speech current of the plate of the 76 returned through the B supply, there would be a corresponding fluctuation of the voltage-drop across that source. Now if the plate speech circuits of the first 6C6, for example, also returned through the same path, the relatively great plate voltage swing of the 76 would be impressed, or fed back, across plate and cathode of the 6C6. Such feedback causes an amplifier to oscillate at low frequency, called "motor-boating". To avoid motor-boating it is necessary either to use a separate B supply for each tube, or, since this is not practical, to isolate the plate speech circuits of the tubes from the B source, by such means as have been traced herein.

The plate of the 76 is coupled to the control grid of the 42 tube through .1 microfarad. The cathode of the 42 is grounded, and the cathode of the 76 grounds through the 5-microfarad by-pass condenser. Thus the plate swing of the 76 is condenser-coupled across the control grid and cathode of the 42. From the plate of the 42 trace downward through the primary of the coupling transformer to ground, and from ground back to the cathode of the 42.

The speech a.c. developed in the secondary of that transformer causes the ends of the secondary to become alternately positive or negative with respect to the center tap. From that center tap trace down, left and down through the 1,000-ohm grid bias resistor to ground; thence back to the cathodes of the 6L6 tubes. The grids of those tubes therefore swing alternately more or less negative (sometimes even positive, at high volume) with respect to their cathodes.

The corresponding fluctuations in the plate currents of those tubes return to cathode (ground) through the center tap of the output transformer primary, thence down, left and down through the 8-microfarad filter condenser. The secondary of the output transformer is tapped to provide impedance match for any desired loud speaker circuit.

The performance characteristics of the amplifier of Fig. 1 are as follows:

Output (to 500-ohm speaker line)	40 Watts
Gain from Photocells	109 db
Gain from Microphone Jack	109 db
Harmonic Content at 40 Watts Output	5%
Harmonic Content at 30 Watts	3.5%
Harmonic Content at 20 Watts	2%
Harmonic Content at 10 Watts	1.5%
Drain on A.C. Power Supply Line	150 Watts



L.U. 182 BALL CLUB, BOSTON THEATRE LEAGUE CHAMPS

Unbeaten projectionist nine, with absolutely no ringers. All games considered complete when one team amasses 25 runs, irrespective of inning. Rumor has it that managers, fearful of blank screens, copious showings of runout trailers, etc., figure it safer to deliberately "throw" the games to Union club. Source of equipment for L.U. 182 club a deep mystery, although managers miss balls, bats, gloves and shirts after each game

More Data on Carbon Arc Power Supply

The accompanying contributions by Messrs. Hertner and Elderkin are in the nature of addenda to the article, "Economic and Technical Aspects of Arc Power Supply," a symposium on the relative merits of generators and rectifiers, presented in I. P. for April (p. 19). Further comment by either of these contributors, or by anybody else having something interesting to say on this topic, is invited, in accordance with I. P.'s well-established policy of providing a forum for the full and free expression of opinion on the projection process.

By JOHN H. HERTNER
HERTNER ELECTRIC COMPANY

IN THE April issue of I. P., Mr. J. K. Elderkin replies to Mr. Dash relative to the report of the S.M.P.E. Projection Practice Committee's report on sources for power for Suprex arcs, etc. The accuracy of the instruments used by Mr. Dash having been questioned, let the record show that they were standard Weston meters, a check on which shows no magnetic influence from the Forest rectifier, as suggested by Mr. Elderkin.

The discrepancy in readings cited by Mr. Elderkin was due to an unfortunate clerical error in repeating the figure "9.6" in the ampere column. The proper figure was 8.85. With this correction, all the figures given correspond within the limts of accuracy of reading. The first test conducted by Mr. Dash was actually conducted on open delta. This results in an unbalanced output with a pronounced ripple. The Scott-connection was used by the Case School, since by that time we had secured an official diagram of connections. The wattage efficiency does not change materially.

Load vs. Efficiency

Mr. Elderkin makes the statement that if Mr. Dash is right in finding a higher efficiency at 40 amperes than at 45, the efficiency goes up with decrease of the load; and Mr. Elderkin further states that if this be so, a load of only 1 or 2 amperes would mean an efficiency of close to 100 per cent.

First, Mr. Elderkin apparently does not know that much apparatus is designed so that its point of highest efficiency is about ¾ load, not only because of lower first cost but also because the average load in service is close to this point. Again, he also does not know apparently, that efficiency curves are not straight lines but are real curves. Following the Elderkin argument in the contrary direction, if the efficiency of a rectifier is higher at full load than at ¾ load, then if loaded heavily it would approach 100 per cent efficiency, and all that would be required to keep a rectifier cool would be to overload it heavily enough—because eventually the losses would approach zero and thus hike the efficiency up to 100 per cent.

Mr. Elderkin wishes enlightenment on Ohm's Law as it applies to ballast and arcs. It is simply this:

If the current across a ballast is to be obtained, the voltage supplied across that ballast must be doubled. With an arc, however, I believe he will admit that to bring the current across a pair of carbons from, say, 25 amperes to 50, it will not be necessary to double the voltage. I believe that the National Carbon Co. has available to those interested tables which show the voltages across the Suprex arc at various current values.

Copper-Oxide Efficiency

In showing efficiencies Mr. Dash has been very frank, I believe, for while Table B shows the efficiency of a generator set without ballast, just below this table in the left-hand column (I. P. for April, p. 21) are the relative figures *including ballast losses*. This should satisfy all fair-minded inquirers.

At the recent S.M.P.E. Convention, Mr. Smith of Westinghouse Elec. & Mfg. Co. treated the copper-oxide rectifier exhaustively. He showed that the efficiency of this unit after some service ranges from 63 to 65 per cent. Coming from the actual owners of the copper-oxide patents, and the source of original research thereon as well, this opinion can be considered as almost final.

As to power-line fluctuations, we know of cases where the use of rectifiers has been abandoned for just this trouble.

By J. K. ELDERKIN
FOREST MANUFACTURING CORP.

MR. HERTNER states that Mr. Dash, of his company, used Weston meters, a check on which showed no magnetic influence. The discrepancy in figures is attributed to a clerical error. I repeat that a Weston or any other make of meter is materially affected by magnetic flux. The type of rectifier tested by Mr. Dash has a considerable magnetic field, and if the test meters were not outside of this field, their readings could not be relied upon.

I see no reason to change my original opinion that the meters used by Mr. Dash, or at least some of them, must have been under the influence of the magnetic field, because the figures submitted by Mr. Dash are replete with discrepancies similar to those showing greater efficiency with lower output wattage than with higher output wattage.

Mr. Hertner intimates that I do not know that much apparatus is designed so that highest efficiency is obtained at ¾ load. I have designed and built rectifiers for more than 20 years, and while I do not profess to be an authority on the subject, I do know that the efficiency of most types of rectifiers, particularly the tube types, increases materially as the output is increased up to the full capacity of the tubes.

It requires only elementary mathematics to prove this point, as follows: A tube rectifier has three places where losses can occur—(1) the transformer, (2) the tube filament, and (3) the arc-drop from anode to cathode in the tube.

Tube Rectifier Losses

The transformer efficiency, as everyone knows, increases with increase in output. The tube filament requires the same energy to heat it at no load as it does at full load; its loss is a constant factor. The voltage across the arc of the tube (arc-drop) is constant, but the losses due to arc-drop vary in proportion with the load.

For example: consider a two-tube, full-wave rectifier with a capacity of 30 amperes at 75 volts. Disregarding the transformer loss and assume that the filament takes, say, 25 amperes at 2.5 volts. There is a constant loss of 25 amps. x 2.5 volts, or 62.5 watts for each tube, or 125 watts for both tubes. Now, let us say that the arc-drop of the tube is 10 volts and that we are operating the rectifier at half-load, or 15 amperes. Thus the arc-drop will be 10 x 15, or 150 watts. The total loss of rectification, therefore, will be 125 + 150, or 275 watts.

The rectifier working at half-load will

(*Continued on page* 29)

The I P EDITORIAL PAGE

Vol. 10, No. 6. JUNE 1936

Projectionist Influence on Equipment Sales

Certain remarks made by the editor of I. P. before the recent Convention of Independent Theatre Supply Dealers in Chicago were accorded a reception a shade less than wildly enthusiastic by at least one manufacturer among his audience. Although I. P. is definitely not responsible for the doings and sayings of its editor in his peregrinations (thank Heavens) this corner is suffused with a warm glow to find itself in complete agreement with the aforementioned remarks of its chief hireling. Citing the Suprex arc as a shining example of how projectionists aid the dealer in making sales, I. P.'s editor said, in part:

"There exists some doubt as to the actual importance of the projectionist as a factor in making equipment sales. The fact that opinion is sharply divided on this important question serves only to confuse, rather than clarify, the subject. However, in the case of the Suprex arc there cannot possibly be any difference of opinion as to the influence of the projectionist upon sales. This is one development the course of which may be accurately plotted along the route of projectionist activity. This is one important piece of equipment in which sales pressure was exerted through the projection room to the offices of either the manager, owner or purchasing agent.

"My people (projectionists) popularized this arc. Proof of this statement is apparent from the fact that a projectionist publication (I. P.) was more than a full year ahead of any other trade medium in transmitting to its readers complete theoretical and practical data on design, installation, operation, costs and efficiency relating to this arc. How was it possible for managers, owners or purchasing agents to pass upon something about which they knew little and were handed less by their own press? The answer is that it wasn't possible; the dope filtered down from the projection room the occupants of which knew *all* about the Suprex arc.

"This incident is proof conclusive that the projectionist can be and is a powerful factor in equipment sales—can be, in fact, an unpaid member of the dealer's sales staff, provided he be properly cultivated."

And so on. Now, it may not be generally known that there has been in progress for a year or more a battle of words among manufacturers of lamps and carbons as to who "invented" the Suprex arc. This featherweight struggle interests I. P. only slightly, because the facts are available with little effort by even those who read as they run. Should this cream-puff battle be ballyhooed, through court action or otherwise, into a topic of importance, I. P. is prepared to give the facts as it understands them—facts gathered quite easily from the record. For the time being, let it lie.

One lamp manufacturer at the Chicago sessions, all too willing to translate "popularized" into "invented", promptly started a campaign against I. P.'s editor by inquiring, behind cupped hand, so to speak, just what the editor thought they (the manufacturer) were doing while projectionists were "inventing" the Suprex arc. This corner, being a pushover for an aside, will bite by replying: "We don't know. What *were* you doing?" Does it hear an echo: "Just what all the other manufacturers were doing at the time—building a Suprex arc according to well-defined and commonly-known specifications (including A. C. jobs, where *all* lamp manufacturers started on the Suprex arc)!"

Meanwhile, however, an alert New York projectionist, Mr. Harry Rubin, unwilling to accept the A. C. job, was converting low-intensity lamps for Suprex D. C. operation! This, too, is part of the record. This, too, is a known fact and tends to remove the speech by I. P.'s editor from the realm of fancy to the domain of fact.

I. P. at the moment is wholly disinterested in the squabble about who "invented" the Suprex arc. The arc is here, we are using it, it is going along fine, and who cares who invented it? The point at issue is whether I. P.'s editor is correct in giving projectionists due credit for "popularizing" the Suprex arc. Repetition being an old reliable trick for lending emphasis, we repeat once more that projectionists, and nobody else, popularized the Suprex arc. The record is quite clear on this and certain other interesting points.

This much having been established, it appears that projectionists certainly do constitute invaluable aids to increased sales by supply dealers.

An 80% Increase In Light For Only $30

Conversion of low-intensity lamps for use of Suprex carbons has been opposed by I. P. since the time D. C. lamps properly designed to do the job became available. The conversion process was all right as a stop-gap, as a means for forcing manufacturers to do the right, the logical thing. The craft knows this story too well to require its recounting here. Now, however, another conversion idea pops up—an offer by a certain manufacturer to increase illumination of low-intensity lamps by about 80% merely by substituting larger reflectors. The cost of this conversion job, incidentally, is $30. Whether it cost $500 or $5, I. P. still fails to see where the substitution of a larger reflector will net any such results—even if it had never heard of such things as carbon company chemical laboratories, magnification ratio, proper carbon feed, adequate lamp ventilation and a few more such insignificant trifles which strangely enough seem to figure in the situation.

Projectionists should not be duped by such offers, a report on which from the field would be appreciated by I. P. Meanwhile, a request for detailed data on the process has gone forward, the answer to which will form the basis for a complete exposition of this matter in an early issue.

I. P.'s Status as a Craft Paper

Writers for the daily trade press, tearing themselves away from the luncheon tables and cocktail bars, which provide them with most of their "news" of executives and roving film stars, suddenly discover that television is a menace to show business. A deluge of wordy but not weighty pronouncements follow. These typewriter-knockers don't know, of course, that all of the stuff spread on the record of the recent hearings by the Federal Communications Commission is a bold lift from Dr. A. N. Goldsmith's classic analysis of the subject, already more than a year old to I. P. readers. Which leads naturally to a bit of speculation upon the many "firsts" which I. P. has scored in servicing its readers.

The dope on television and its relation to the motion picture was served up piping hot a year or more ago—before it was hash, such as is being circulated today in the industry

(*Continued on next page*)

New Constitution, Longer Elective Terms Mark Serene 33rd I. A. Convention

THE adoption of a new constitution, the extension of the terms for all elected officials from two to four years, and the uncontested re-election of all incumbents by acclamation featured the 33rd Biennial Convention of the International Alliance, held in Kansas City, Mo., June 8 to 11. So serene was the convention atmosphere that adjournment was voted at noon on the fourth day, setting a precedent for I. A. gatherings.

All Convention sessions were held in the new $6,000,000 Municipal Auditorium which for size, layout and appointments surpasses anything of its kind in the world. At least two adjuncts of the hall in themselves challenged the progressivism of the Alliance: the new multiple-throat speakers, and the Thyratron electron-tube general lighting control.

The real business of the Convention, apart from the extension of officers' terms and the election was contained in the President's Report, all other activities providing merely an outer shell for, and converging upon, this important document, which contained a resume of Alliance activity during the past two years and charted the course for the future.

President William Green of the A. F. of L. honored the Alliance with his presence, the first such instance on record, and in his address flayed the U. S. Supreme Court for its adverse Labor decisions, particularly in the N. Y. State Minimum Wage Case. He cited the present extensive organizing activities of the A. F. of L. as an indirect slam at the industrial union block headed by John L. Lewis of the U. M. W. Concluding his address, which was extremely long and suffered fom repetition, President Green evoked a large-scale demonstration by pledging full support to I. A.

Rabbi Jacob Tarshish repeated his Columbus Convention performance by delivering an address on social welfare that was replete with studied vocal and rhetorical flourishes such as have characterized his extensive radio activities.

President's Report All-Inclusive

The salient feature of the first session and entire Convention was the report rendered personally by President George E. Browne, whose delivery constituted an exceptionally fine performance in itself and matched the generally good construction of the document, which gave every evidence of careful consideration and preparation. Particularly appealing was the exclusion from the report of any personalities in connection with the several trying incidents which have marked the President's work within the past two years —a feature which has marred similar efforts of the past.

Browne prefaced his report by stating frankly that he visualized the General Office as a laboratory, and his personal efforts as almost entirely experimental, being directed toward meeting exigencies as they arose, as opposed to a set general policy. He had been away from the General Office more than 70% of the time since his election, he said, and had found this practice beneficial through providing closer field contacts.

Details attendant upon I. A. intervention in the affairs of various Local Unions were given, applicable to locals 306 (N. Y. City); 171 (Pittsburgh); 110 Chicago; 170 (Kansas City); 143 (St. Louis); 691 (Salem, Mo.); 489 (Gary, Ind.) and 496 (South Bend, Ind.). Of these situations, only Kansas City and New York City have not reflected distinct improvement, and a promise to straighten out these spots shortly was made. The Canadian situation, the result of dual-union activity which plays upon the nationalistic spirit of Canadian employers and theatregoers, will also have immediate attention.

Specific comment on various sections of the U. S. showed that I. A. fortunes are definitely on the upbeat, with the last contract season witnessing sharp

Editorial (*Continued from preceding page*)

press. At least one semi-technical paper is now presenting Suprex arc data which ran in I. P. two years ago. The sound system servicing racket of certain equipment companies was first exposed in these columns. Projectionist takeover of this work, which properly belongs to the craft, is another original I. P. job—and how! Step-by-step analysis of sound equipment, in a form now weakly imitated by other journals, was another I. P. first. Extended servicing plans of major sound companies was killed by I. P.—so the sound companies themselves admit. (We wish they could complain more loudly.) I. P. has been first on every advance in recording and reproducing equipment and technique for the past five years. The mystery of those sealed-up amplifiers was exploded in these pages. Manufacturers have been forced by I. P. to make available necessary operating information. I. P. has publicized *by name* inferior products—an *unprecedented* procedure within trade press ranks—and it has provided a forum for the expression of all shades of opinion. The current issue is a good example of the diverse topics covered by I. P.: a complete amplifier is traced in detail; a brand new tube is described; data on a new carbon is presented; a presumptuous lamp manufacturer is spanked, and so on.

Publicly the industry trade press hollers long and loudly that the projectionist doesn't mean anything, that he isn't a factor in equipment distribution. Privately they almost break their backs trying for projectionist circulation and attempting to serve projectionists—"attempting," we say, because they are invariably left at the post by this publication. I. P. is more than a technical paper, it is a craft paper. It boosts quality work, true, but it is equally insistent that this work be done under favorable surroundings (adequate ventilation, etc.). It also is interested in how much the projectionist goes home with at the end of a week, and in guarding against raids upon projectionist welfare so that he may have a job to go to week after week. Hundreds of letters to I. P. never reach its printed pages; and no computation of time spent in the field by I. P.'s editor on craft legislative work (for carfare only) has been made.

Publishing a craft paper, serving projectionists means very much more than merely running editorial copy alongside advertising. I. P. does its job as a craft paper, on all fronts, up to the hilt. Certainly it beats the others to the punch on vital technical data, and this, in addition to its widespread endeavors in behalf of the craft, makes I. P. the projectionist organ in something more than merely name. That support which I. P. receives (and it should be greater) is earned.

advances on a wide front with respect to wages and conditions. A feature of this presentation was evidence bearing on the elimination of dual unions in entire districts.

Browne disclosed that the I. A. General Fund now contains $90,906.74, with outstanding liabilities of only $2,491.59. Total membership of the Alliance as of May 15 last is 28,877, reflecting a gain of 5,635 over the May, 1934, membership figures. Classification of these added members was not attempted.

Extension of Jurisdiction

Disclosing the reasons behind his move to gain jurisdiction over all other theatre employees—cashiers, doormen and ushers—Browne cited the existing uncertainty among A. F. of L. affiliates as to the form union organization should take in the future. He added that his successful application to the Executive Council for jurisdiction over the aforementioned workers was predicated on his desire to "take no chances" that another affiliate would lay siege to these groups. His future course in this respect had not been decided, he said.

Browne gave the delegates something to think about and act upon by announcing that a U. S. Government survey disclosed that out of 14,000 theatres listed in their files as open and operating, only 5,000 are employing I. A. members. While not exerting any particular pressure to make a Convention issue of the matter, Browne's vocal inflection and manner of conveying this information left no doubt as to what he thinks about the situation.

A strenuous appeal in behalf of stagehands was voiced by Browne, who appealed to all projectionist locals to extend to members of sister stagehand units every possible help in providing employment opportunities. The legitimate field is improving slowly, he said, but meanwhile stagehands must have the assistance of other locals. Admitting that stagehands were openly contemptuous of sound projection work at first, and even recently have not exhibited much enthusiasm about such work, Browne gently chided stagehands for their unwillingness to help themselves by grasping the chance to learn projection.

In appealing to projectionist locals for cooperation in this respect, Browne stated that he had had followed this policy in Chicago Local 110, which, when taken over by I. A., was found to have 213 "permit men" employed to the exclusion of even regular card members. Most of these workers were replaced by regular card men, the balance of the jobs being filled by stagehands from Local 2.

Portable projection was said to offer many employment opportunities, which, however, require unrelenting vigilance by projectionist locals. A single company in the 16 mm. industrial field (Jim Handy) employs 60 I. A. men, it was reported; and this situation could be duplicated everywhere, said Browne, by proper attention to I. A. requirements.

Browne recited his view of events which led up to the levying of the special 2% defense fund assessment, discontinued on Feb. 29 last, and said that this move had frustrated well-laid plans of "the opposition" (evidently meaning employers and other ambitious crafts) to blanket the I. A. in the theatre field. The death of the NRA, said Browne, was hailed by employers as an opportunity to deal I. A. its death blow: but widespread publicity anent the defense fund caused a cessation of such "conniving."

More than 2,000 stagehands are employed on the Federal Theatre Project, it was stated, with more than 200 of these being members of Local 1, the project having had its inception in N. Y. City. Although hours of work are necessarily limited, the scale of pay approximates the regular road scale on a per diam basis.

Interest in Servicing, Schematics

Sound equipment servicing occupied a prominent niche in the report. So important to projectionists is this topic (I. P. having generated popular interest therein through strenuous battling for the past two years) that verbatim excerpts from this section of the report accompany this article. An important resolution bearing on this same point, appended hereto in part, was referred to the incoming Board:

WHEREAS, manufacturers of sound equipment, and their service men, continually revise, change or modify equipment operated by Alliance members, and

WHEREAS, said manufacturers, after making the above-mentioned revisions, changes or modifications, fail to supply proper diagrams of wiring, ... therefore be it

RESOLVED: That all manufacturers of sound equipment be required to place a correct schematic and wiring diagram on each unit of equipment; this diagram to show clearly the value of the individual component parts of the equipment; also, all changes, alterations or modifications in equipment are to be supplied immediately, upon the completion of the above-mentioned changes, for posting upon said equipment, so that said equipment may receive proper care and handling by those in charge of same, namely, members of the I.A.T.S.E. & M.P.M.O.U.

W. C. Kitzmann, Local 509
George Chalmers, Local 487
J. R. Marksbury, Local 355
Walter T. Haesley, Local 416

Referring to the impending vote on acceptance of the proposed new constitution, Browne said that two years in the General Office had convinced him of the utter inadequacy of the old governing document. A new constitution was necessary principally because Labor in general, and particularly certain units of the Alliance, had become legal-minded, with the result that both the local units and the Internationals were being pillaged by "unprincipled attorneys" who through defects in the governing charter were able to inflict severe financial and other damage upon Labor organizations.

The new constitution, said Browne in recommending its adoption by the Convention, was the product of two years of effort and careful analysis by expert Labor lawyers, who had carefully scanned the laws of all first-flight organizations in the work of compilation. The special committee of 60 I. A. men assembled from every geographical section of the country some days prior to the convention to consider the new constitution was cited by Browne as indicative of his desire to uncover every possible shade of opinion thereon.

The reading of the new constitution

(*Continued on page* 27)

I. A. Pres. Browne's Report on Sound System Servicing

"With the introduction of sound . . . the greatest revenue derived by the two major companies . . . was the long-term service contract . . . We can readily see what that amounted to in revenue to those concerned.

"At first, with few exceptions, our locals welcomed the sound service men, as our members were not familiar with this new phase of work. With the expiration of the service contracts, which started during my tenure of office, our locals started to insist upon the handling of that work, and rightfully so.

"Many of our locals, anticipating just such a situation, made arrangements to take over this work formerly done by the sound service men. Some locals had already taken in capable sound service men, who, aside from their regular duties, acted as tutors for the remaining members . . . One District . . . passed a resolution . . . that any I. A. member doing this service work would be permitted to work in the jurisdiction of any local union in that particular District. This matter became of International importance in view of the fact that most of the service was performed by employes of the two major companies. I assigned a special representative to start negotiations for the unionization of this branch of our industry.

"While time did not permit me to finish this work, . . . much progress has been made. In fact, an offer of $90.00 per week has already been made . . . by major companies for sound service men, who are to be members of the Alliance exclusively."

Another I. P. 'First'—

The 6L6 — A Radically New and More Efficient Beam Power Tube

By AARON NADELL

What does this new 6L6 tube mean to the projectionist and to theatre sound projection? Technical data is appended hereto. Its practical worth may perhaps be best illustrated by a comparison with, for example, existing Erpi 242-type tube. A pair of 242's, at a list price of $18 each, deliver 12 watts (with a late type, not yet introduced generally, expected to deliver slightly more). A pair of 6L6's, costing only $1.18 each, deliver 40 watts!

Use of the 6L6 tube means lower amplifier cost and lower power supply cost. The drastic reduction in tube costs means increased efficiency of operation by means of a greater stock of spares. Introduced by RCA, the 6L6 will be manufactured also by Raytheon, Sylvania and others.—*Editor*.

POWER-handling abilities greater than those of most tubes hitherto used in theatre work are combined in the new 6L6 with the small size and low cost of ordinary radio receiving tubes. Entirely new principles of construction and operation have been built into the 6L6, which in design is a tetrode, functions as a pentode, and delivers the high quality of a triode.

The 6L6 is available both in glass and metal forms. The outstanding features of its construction are: oval-shaped cathode, carefully aligned grids, inclusion of deflector plates to form an electron beam, and curved recesses in the anode plate upon which the beam is received. The unusual characteristics of the tube are obtained by taking advantage of a handicap. The space charge created by the presence of moving electrons in a vacuum has until the present created problems and difficulties which tube designers have attempted to avoid by various expedients, particularly, the inclusion of a fifth, or suppressor, grid in pentodes. In the 6L6, space charge becomes one of the elements of the tube, which assists its operation and is utilized to increase power and reduce distortion.

Triodes, Tetrodes and Pentodes

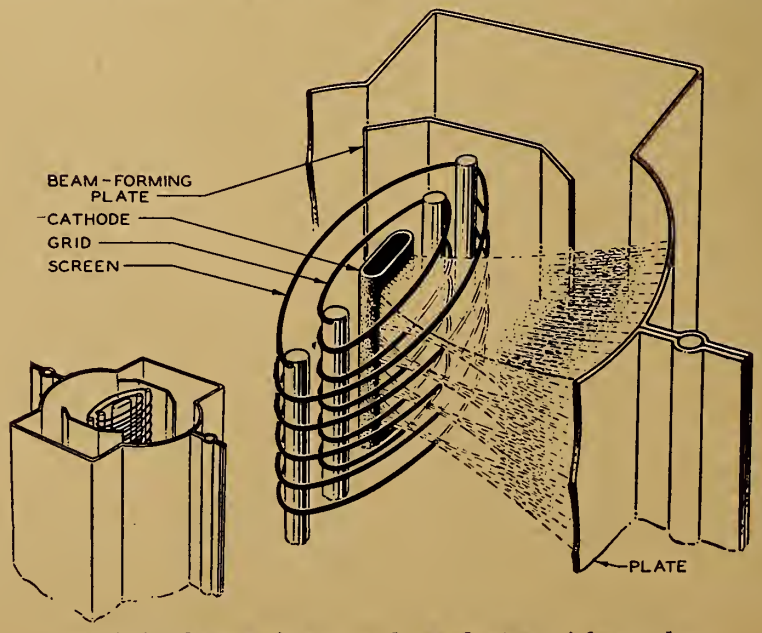
In the ordinary *triode*, amplification is limited by the capacitance existing between plate and grid. The signal input is connected in series with the grid voltage, or bias, and the bias is modified, or "swings", in acordance with changes in the signal voltage. The amplifying action of the tube results in the creation of a corresponding plate voltage "swing" of greater amplitude.

Plate and grid, however, constitute a charged condenser, and it is impossible to change the charge of one plate of a condenser without producing a corresponding alteration in the charge of the other plate. When the plate swing of an ordinary triode becomes large, at high volume, the feedback to the grid *via* the condenser action of the two elements may become great enough to cause the tube to oscillate. Amplification per tube must therefore be held down accordingly.

In the *tetrode* (a screen grid tube) a positively-charged screen grid is introduced between the plate and the control grid. In consequence, the capacitance between control grid and plate is greatly reduced, and much higher amplification is possible. In the ordinary tetrode amplification is limited by secondary emission. The positively-charged screen grid serves as an electron accelerator, increasing the velocity with which electrons contact the plate. The plate is heated, resulting in emission of electrons from its substance, and there is also emission by virtue of the impact of electrons. The emitted electrons are attracted toward the positively-charged screen grid, and, if their energy of emission is sufficiently great, will go to that grid and not return to the plate. The plate thus loses electrons (which constitute current) limiting the plate current and hence the amplification per tube.

In the *pentode*, a negatively-charged suppressor grid is placed between the plate and the screen grid. When secon-

(*Continued on page* 26)



The 6L6—showing formation by grid wires of beam sheets

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

RCA PHOTOPHONE dug deeper chunks of business out of the Erpi strongbox during the month. 20th Century-Fox and Warner Bros. were signed by RCA to 10-year recording licenses, which, with Columbia, makes three major producers to flop over to RCA within a month. Other RCA recording licensees are RKO, Republic and Walt Disney. Deals with Paramount and M-G-M are expected to be closed shortly.

The new RCA agreements include free installation, wiring, and spare and renewal parts; a single fee for pictures recorded in this country and distributed throughout the world, no charge for recording trailers, with the recording charge based on running time in the theatre. Erpi's charges are on a per-reel basis. A 20th Century-Fox spokesman said his company made the deal because RCA has a good system, including several valuable improvements, such as push-pull recording, which were considered very beneficial.

RCA's deals with the aforementioned majors, as well as those offered to Paramount and M-G-M, are known by I. P. to include provision for use of a substantial number of RCA High-Fidelity reproducers in the theatre field. Columbia has no theatres; but RCA's pact with Warner, Fox, Paramount and M-G-M will increase materially the theatre field use of Photophone.

Erpi's Future Uncertain

Of course, events leading up to this clean-up of the studio and theatre fields by RCA are no secret to I. P. readers. The future of Erpi is a matter for keen speculation within the trade, because the RCA deals mean a double blow on the score of recorders and reproducers. Erpi has already notified licensees that it will meet the RCA recording rate slash; but it seems unlikely that Erpi can match RCA in the theatre field. The trade press printed unqualified reports that negotiations are in progress for the purchase of Erpi by a group of major companies; but this news should not surprise I. P. readers, who as long ago as last August knew that Erpi had been offered to Atlas Corp., N. Y. Investment house. A. T. & T.'s readiness to dispose of Erpi, as a protective move for its primary interest in the communications field, has long been the topic of widespread discussion in the picture industry.

Independent Dealers Sponsor Very Successful Convention

Bigger and better than ever was the recent sixth annual convention of the Independent Theatre Supply Dealers Assoc., held in Chicago, June 5-9. Particularly noteworthy was the equipment exhibit, which for quantity and quality exceeded any similar display in the history of the business.

Officers of the Association for the ensuing year are: president, H. W. Graham, Denver; vice-president, K. R. Douglass; treasurer, W. J. Katz, New York. Directors are B. F. Shearer, Seattle, retiring president; J. C. Hornstein, New York; George McArthur, Detroit, and A. F. Marrone, Pittsburgh. J. E. Robin, of New York, will continue as executive secretary.

Reports submitted to the convention showed that the organization is in excellent shape, with several additions to the membership expected shortly. Attending dealers and manufacturers transacted much business and exchanged ideas on the manufacture and merchandising of equipment.

Lower Erpi Recording Rates July 1; New Theatre Set

Lower Erpi recording license rates will become effective July 1, it is announced. The rate cut of from 33 1/3 to 40 per cent below present levels will save the industry at least $400,000 annually, Erpi admits. Erpi first denied then announced lower rates, which were forced by RCA cut. New Erpi reproducing equipment due soon expected to bear much lower price tag.

New Long Reel Bows Sept. 1; Fix Switch Cost at $900,000

Further postponement to Sept. 1 of the official bow of the new standard double reel has been agreed upon by major producers in order to allow more time for the manufacture and distribution of the reels. *Variety* opines that introduction of the new reel standard will cost the industry $900,000 during the first year, the largest expense being from $200,000 to $300,000 for new reels, expected to hit an average cost of 37½c each.

Shipping cases, it is estimated, will cost an additional $125,000. Alterations of exchange racks, new rewinders, bands and other essentials constitute the balance of the expense. New rewinders are geared to a 2¾-to-1 ratio, the old type being geared on a 4-to-1 basis. Reduction in size of the reel will enable continued use by small-town exhibitors of old equipment.

Denmark Accepts SMPE 16 mm. Standards; Accord Hope Grows

Denmark has adopted the S. M. P. E. standards for 16 mm. film and has certified its acceptance to the International Standard Assoc. Following closely upon the similar decision of Great Britain, considerable progress is being made toward attainment of a world-wide set of specifications for 16 mm. equipment and film.

The issue was raised last summer at conferences at Paris and Berlin, during which a set of proposals was advanced by the Germans that would put the sound track upon the opposite edge of the film from that specified by the S. M. P. E. and would likewise transpose the position of the emulsion with respect to the sound track. Up to the present, countries that have adopted the S. M. P. E. Standards are the United States, Great Britain (including England, Canada, and Australia) Holland and Denmark.

British Television July 15

British Broadcasting Corp. will seek to popularize television by etherizing images to receivers set up in department stores and radio shops. "Experimental" television is expected to be launched in England on July 15, although the idea for a "television theatre" has been abandoned.

W. F. Canavan, Jr., 10, Drowned

William F. Canavan, Jr., 10, was accidentally drowned recently when he slipped into a large water hole in an old creek bed, three blocks from his home on Teasdale Ave., University City, Mo. His friend, able to swim, escaped after being pulled into the water. The boy's father, now employed as projectionist in the Shubert-Rialto, St. Louis, is a former president of the I. A. T. S. E.

Outdoor Television Shown; 1½ Years to Home Sets?

TELEVISION outdoors was demonstrated recently in a mile broadcast by RCA-Victor research engineers in Camden, N. J. A special alarm was sent in for firemen, and as they rushed up to the scene of the "blaze" the eye of a television camera poked out of a window to record the activity, while a microphone picked up the clang of the bells and roar of the sirens.

Television spectators a mile across the city watched the "fire." In a greenish-hued picture, 5 by 7 inches on top of the radio set, the observers saw the fire fighters scale the ladders to extinguish the "fire" on a roof about 100 feet away from the electric "eye" of the television camera known as an iconoscope.

Smoke curled up from the roof, and the hose "splashed" water across the television screen. Passers-by who gathered in the street were pictured unbeknown to them, as were automobiles rushing across the bridge in the background. Even the

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billboards and budding trees showed up clearly in the radio picture. The attendant clamor came clearly over the loudspeaker.

33-Tube Complex Circuit

The latest television receiver at first glance looks like an ordinary console radio, but inside the mechanism is radically different, more complex. There are 33 vacuum tubes in the circuit compared to the average broadcast receiver's 12. Adding to the complexity are 14 control knobs, 7 white ones arrayed on the front of the cabinet and 7 black knobs on the top. They regulate the sound, govern the brilliancy of the picture, focus, synchronize, center the image, regulate its size and generally refine the image.

Tuning is accomplished by a single knob, because the sound-sight is *combined on one wave*, and once the sound is accurately tuned the picture "takes care of itself," as the engineers explain the operation. The images travel on a six-meter wave.

On top of the receiver cabinet, under a hinged cover, is a large funnel-shaped cathode ray tube called a kinescope, protruding through a circular opening. The end of this tube is covered with a fluorescent material. There the image is "painted" electrically. The cover of the set can be raised so that the image from the tube's face is reflected from a mirror to the spectator. These kinescopes are estimated to cost from $50 to $100, depending upon the number produced. The cost is taken as an indication of what the multi-tube home-television instruments may sell for, probably $300 to $800, according to the engineers, who report no definite retail price has been established.

As further evidence of television's prowess in handling the "show", guests were pictured as they stood under the glare of powerful studio lamps. Films were also projected. It is believed that reels will be the backbone of television.

30 Frames a Second

The film is broadcast by television at the rate of 30 pictures a second, although the film passes through a projector at 24

How Many?

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pictures a second because the associated sound is recorded at 24 frames a second. What happens to the other six pictures the television engineers hold as a secret, for this sleight-of-hand is one of their tricks. The receiving antenna is only 10 feet long.

Engineers describe the system as "all-electronic." No mechanical parts are utilized. There are no whirling disks festooned with lenses, as in early television methods. Scanning is now electrical.

The radio camera's "eye" is a large, simple-looking "eyeball," the retina of which is a mica plate covered on one side by millions of particles of light-sensitive material; on the back is platinum. An electron beam sweeps across the optic 10,000 times a second to register the image on the radio "brain," or transmitter.

The received picture is comprised of 343 interlaced lines designed to minimize flicker. The green tint of the pictures is purposely arranged because the human eye is more sensitive to that color, according to Dr. V. K. Zworykin, inventor of the kinescope and iconoscope. He said the ultimate home-television receiver will probably offer a pale yellow picture.

Not for 18 Months

"This demonstration is a prelude to the tests to be instituted in New York late in June", said R. R. Beal, director of the RCA television committee. "There are so many problems involved that we do not know exactly when television will reach the home. Much will depend upon the New York experiment. It is safe to say that home television is at least eighteen months away. Television today is a plaything of the research engineers, but as this demonstration proves, they are now ready to take it from the laboratory to the outdoors.

"The tests this Summer represent pioneering efforts. There are three major divisions of study—equipment, ultra-short waves and program technique. We have absolutely no intention of introducing image receivers for the home this Autumn. Transmitters and receivers must be standardized before television can go down the manufacturer's production line."

Tube Visualizes Electrons

Making electrons "visible" to simplify the study of electronic phenomena is now possible through the use of a new tube developed by Westinghouse engineers. The new tube has a fluorescent coating on the plate that "illustrates" electron bombardment for demonstration purposes. Like other three-element electronic tubes in fundamental design, the new tube has been especially constructed with a fluorescent coating on the plate. Electrons striking this coating are transformed into visible bands of radiations whose widths depend directly upon the electron beam intensity. Thus, the electrons passing through the grid to the anode form a visible pattern which corresponds to the invisible pattern in a more conventional tube.

The effects of grid voltage on this transmission are illustrated by changes produced in the strips of light on the plate. A constant, high negative grid voltage will reduce the bands to fine lines, while a constant positive voltage on the grid will cause the bands to expand to widths sufficient to cover the plate completely. Thus, it is possible to illustrate the fact that a direct relationship exists between the electron flow in a tube and its plate current, namely, that a change in the flow produced by the grid in turn varies the plate current.

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THE 6L6—A NEW AND MORE EFFICIENT BEAM POWER TUBE

(*Continued from page* 22)

dary emission occurs, electrons emitted by the plate are repelled by the suppressor grid and forced to return again to the plate whence they came, and further amplification becomes possible.

Amplification in a pentode is limited by several factors, one of which are the "electron shadows" created by the end-supports and the wires of the positively-charged screen grid; and also by distortion, which at high amplificatoin becomes very pronounced. A large component in pentode distortion is of third, or other uneven orders of, harmonics that cannot be balanced out by use of push-pull circuits. This form of distortion is to a considerable degree caused by the irregular field charge gradient resulting from the introduction of a negative grid between a positive grid and a positive plate.

Characteristics of the 6L6

The design of the 6L6 is such as to reduce harmonic distortion of uneven orders as far as possible. The designers have effected this result at the cost of increasing second-harmonic distortion, which is of no practical consequence, since it can readily be eliminated from the output by use of suitable circuits, such as push-pull.

In the new tube, there is little emission toward the end supports of the grid structure. Deflector plates, negatively charged by internal connection to the cathode, are mounted beyond those supports and have the effect of repelling emission toward them, concentrating the electrons into a beam. This concentration is further enhanced by the use of an oval-shaped cathode, the narrow ends of which oval are pointed toward the grid supports and the deflector plates. The broad sides of the oval, from which emission will naturally be greatest, face in the direction in which the beam of electrons is desired.

There are two grids in the 6L6, which is structurally a tetrode—the control grid and the screen grid. They are oval shaped and consist of an identical number of turns so mounted that the wires of the screen are directly in line with the wires of the control grid. The electrons pass between the turns of the two grids in broad "sheets". The dispersion of the electrons beyond the screen grid unites the sheets into a single beam. In the tube as a whole there are, of course, two beams, one to either side of the oval-shaped cathode.

Beyond the screen, the plate is recessed to receive the beam, and the opening of the recess is in effect negatively charged by the presence of the oncoming beam of negative electrons.

The plate and the screen grid are, of course, positively charged. Close to the plate, and close to the screen grid, the effect of the negative beam is overcome by the positive charges placed upon those elements by the circuits of the amplifier. Those voltages are so chosen, in correlation with the geometry of the tube's design, as to effectively suppress secondary emission.

The power-handling capacity of the 6L6, therefore, rests primarily upon three factors:

1. Deflection of emission away from the grid end supports, and consequent elimination of electron shadows due to those supports.

2. Aligning of the screen grid wires with the control grid wires. Since the control grid is given a negative bias, the bulk of electron travel lies midway between its wires, rather than close to them. By alignment of the two grids, the positively-charged screen wires are removed from the path of greatest electron flow to the regions of least electron flow. This construction reduces the screen grid current, and correspondingly increases the useful plate current.

3. Substantially complete suppression of secondary emission through the presence of a "virtual cathode"—a "wall" of oncoming electrons across the opening of those recesses in the plate toward which the beam is directed. This form of suppressor does not produce the third-harmonic distortion created by the presence of a physical suppressor grid in the same location, and permits higher amplification with less distortion of the kind that cannot be balanced out by use of suitable circuits.

Some of the characteristics of the 6L6 tube are:

Heater voltage: 6.3,
Plate Voltage: 200 to 400,
Screen Voltage: 125 to 250,
Control Grid Voltage: -9 to -25,
Plate Current (Signal Zero): 24 to 112 ma.,
Plate Current (Signal Maximum): 24.3 to 230 ma.,
Screen Current (Zero to Maximum Signal): 0.7 to 20 ma.,
Maximum Output (One Tube): 11.5 Watts,
Maximum Output (Push-Pull): 60 Watts.

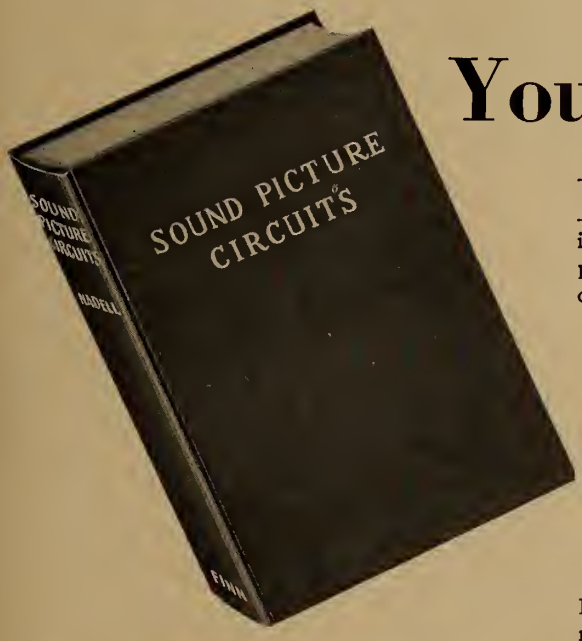
The ranges in values above given refer, of course, to operation of the tubes under different conditions. As these lines are written, the 6L6 is available on the open market at $1.18 apiece.

NEW CONSTITUTION, LONGER TERMS AT I.A. 33RD MEET

(*Continued from page* 21)

on the third convention day was essayed by Third Vice-President Holmden, who, incidentally, was accorded special appreciation in the President's report for his arduous duties in the field during the last two years. Browne said that Holmden had been away from home on official I. A. business for 18 out of the 24 months, and the extent and nature of these services impelled him to extend the warm tribute he did.

It appears neither necessary nor desirable that the new constitution be de-



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scribed in detail herein (which data will run through the usual local union channels) thus only the highlights will be mentioned. In addition to tightening up on the legal end, as previously mentioned, the new constitution clarifies and throws greater protection around a member on the appeals chain from the Local to the Convention floor. Provision is made for appointment of a general counsel to the I. A. at the discretion of the President. Migrations of members of defunct locals to other territories require the permission of the General Office, unless approval is had from officials of the Local to which a member wishes to migrate. Provision is made for extending the influence of the Official Bulletin through the appointmen by the President of an editor thereof. The emergency clause, relating to I. A. control over affiliated unions, is clarified. Every new member of the Alliance must sign a pledge assenting to compliance to the Constitution, which procedure is expected to effect a sharp cut in court cases.

Resolutions submitted to the convention included endorsement of President Roosevelt, which passed; advance listing of road attractions in the Bulletin, referred to Board; several relating to a retirement, hospitalization and old-age fund for I. A. members of long standing, referred to Board; small non-union theatre situation in jurisdictions of smaller Locals, referred to Board; the deplorable conditions existing in Western Canada, referred to Board; the exclusion fom voice, vote or wage negotiations of any member having a stock or other interest in employing companies, failed of adoption; that the International President be empowered to investigate feasibility of a bill in Congress to include Government projectionists in Civil Service Act; provision for a four-week vacation with pay for all International officers, which passed; and the usual expressions of confidence in the officials by the various districts.

Extension to four years of the term of office for all elective posts, as previously mentioned, was contained in a resolution, as was acceptance of the new Constitution. There being only one nomination for each office, the oath was administered in group form by ex-President James Lemke of N. Y. immediately following the casting of one ballot by the Secretary. Conventions will continue to be held biennially, as formerly. Space limitations forbid inclusion in this report of more than an outline of the actual business transacted; but it can be added that the social side of the Convention was not entirely neglected by the delegates, who were more than welcome to Kansas City merchants and amusement impressarios. I. A. practically took over the town for a week, with K. C. doing all right by the boys and the boys doing all right by the town in return. The merchants sang several types of blues when the delegates left town 'twas ever thus.

Convention Resolution Blasts Equipment Change Secrecy

W. C. Kitzmann's resolution to the I. A. Convention anent sound company refusal to supply diagrams showing all changes made bore fruit immediately. Prior to the Convention the electric's serviceman stated that in future no such data would be supplied, irrespective of the nature of equipment modification. In went the resolution.

When Mr. Kitzmann returned to Duluth, following the Convention, he was waited upon by the electric's district manager, who eagerly sought to explain that he had promulgated no such ruling relating to secrecy on system changes and that the serviceman (evidently the goat in this situation) had acted entirely upon his own volition.

Result: Mr. Kitzmann, and all others who yell loudly enough, will be supplied with data relating to all changes in equipments.



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Equipment Representatives Present

Although no organized equipment exhibit was held in connection with the Convention (a matter which might be given serious thought the next time, with profit to the delegates) several enterprising companies were represented at the proceedings, including H. Griffin and P. A. McGuire, of International Projector Corp.; Bill Kunzmann of National Carbon Co.; Don McRae, of J. E. McAuley Mfg. Co.; Walter Hirschfeld, of Motiograph, and Wayne Brenkert, of Brenkert Light Projection Co.

RCA thrilled the delegates by playing to a capacity house with a demonstration of its new Ultra-Violet recording process, reproduced by High-Fidelity equipment. Getting a bad break in the weather (it was nearly 100° in the demonstration quarters) the RCA boys still put on a knockout show and were entitled to all the praise they received. Jim Frank introduced the show with interesting explanatory data, while the RCA Service Dept. was represented by Ted Ostman, national service manager, and Messrs. Yahr and Goodman, all of whom discussed service angles with the delegates.

The Ultra-Violet Recording Process has been described in detail in past issues of I. P.; but a special folder containing Mr. Frank's remarks thereon is available from I. P. for the asking. Don Davis, irrespressible RCA representative in K. C. was also very much in attendance.

Projection People Active

H. Griffin and P. A. McGuire, of International Projector Corp., did an enormous amount of fancy circulating, in addition to holding innumerable conferences and addressing various meetings of projectionists. Their addresses before the N. Y. State Projectionist Assoc. were particularly effective.

Bill Kunzmann was telling all and sundry about National's Suprex, new H-I, and magnificent studio carbons (although he gave no samples and paid no refreshment checks that were noticed): In fact, when turned down on a check at his own hotel, Bill cashed

the check with Herb Griffin, who promptly walked out to the desk of Bill's hotel and cashed it!

Motiograph and Brenkert collaborated on a joint display at the Convention hall, presided over by Walter Hirschfeld and Wayne Brenkert. Color seems to be invading the projection room, judged by the spiffy brown finish of both projector and lamp. Nobody trucked away the display during the night.

The work of these equipment representatives uncovered an enormous amount of interest in technical matters on the part of the delegates and pointed clearly to the desirability of sponsoring an official equipment display at the next Convention two years hence.

MORE DATA ON CARBON ARC POWER SUPPLY

(*Continued from page* 18)

be delivering 75 volts x 15 amps., or 1125 watts; but to deliver this the input must be 1125 + 275, or 1400 watts. The efficiency, therefore, is:

$$\frac{1125}{1400}, \text{ or } 80\%$$

Now, operating at 30 amperes (full load) the filament loss still will be 125 watts; the arc-drop loss will be 10 x 30, or 300 watts. The total loss, therefore, will be 300+125, or 425 watts. The output is 75 volts x 30 amps., or 2250 watts, while the input is 2250+425, or 2675 watts. The efficiency now would be:

$$\frac{2250}{2675}, \text{ or } 84\%$$

Mr. Hertner observes that if efficiency increases with load, as I asserted, correct procedure would involve loading the rectifier so heavily as to reduce the losses to zero and thus keep it cooler. This statement is not even applicable to a tube rectifier because everyone knows that the total losses in a tube increase with load, but that one of the losses (filament heating) remains constant regardless of load. Thus, the efficiency of a tube will increase with increase in load.

In endeavoring to enlighten me on Ohm's Law, Mr. Hertner states that in order to double the current across a ballast one must double the voltage across it; but that to double the current across the arc it is not necessary to double the voltage. This observation has neither added to my understanding of Ohm's Law nor has it upset the law.

An arc of a certain length requires a certain voltage to sustain it, the appellation for which is "arc-drop", the same term mentioned previously relative to the rectifier tube. The crater of the arc emits electrons just the same as does the filament of a tube. The arc-drop voltage depends upon the material of the electrodes, the arc distance, the nature of the surrounding atmosphere and the temperature of the crater.

The drop across a resistor (ballast) depends upon exactly the same things—material, length, atmosphere and temperature.

Arc Light Variations

Once an arc is struck and burning it has a certain resistance which can be measured in ohms the same as any resistance or ballast; and if the arc length be doubled, it will take twice as much voltage for the same amperage, in just the same manner as the doubling of length of resistance wire will require double the voltage for the same current.

The resistance of an open arc varies continuously due to changes in gas generated, differences in crater temperature and arc spacing; and these changes can be practically instantaneous; whereas a ballast will not vary in its resistance instantaneously.

Mr. Dash attributed these changes in current demand by the arc to variations in power lines feeding the rectifier. I suggested the substitution as a load of a resistance instead of the arc. The resistance would not vary in value suddenly, and this would show clearly that the output from the rectifier was constant, variations being traceable directly to the arc itself. I also stated that by putting ballast in series with the arc, an ammeter in the arc circuit would show little variation because the ballast would not change in resistance value as rapidly as would the arc, and the latter, therefore, would simply take an average current.

I repeat that with sufficient ballast in series with a Suprex arc, an ammeter also in series will show little variation in reading; *but the light from the arc will vary in intensity as the arc resistance varies.* With an arc supply that has no ballast the ammeter will show the changes in arc resistance, but with this condition the light from the arc will not vary in intensity. I stand ready to accommodate either or both Messrs. Dash and Hertner by showing them how to set up an oscillograph and photocells to prove this point.

I readily and gladly admit that both these gentlemen have had considerably more experience with ballast than I have,

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as ballast is a quite necessary adjunct to their equipment but a thing to be avoided where efficiency is required, such as a rectifier.

Relative to arc voltages, I have not found it necessary to go to National Carbon Co. for these data, as I believe that in designing equipment it is best to obtain such values by personal experience and observation. If Mr. Dash had followed this procedure, he hardly could have made the statements he did in his reply to me under the sub-head "Arc Voltage Reference" (I. P. for April, p. 20).

'Overall Efficiency' Meaning

I cannot quite agree that Mr. Dash was wholly frank in his references to efficiency in the aforementioned contribution to I. P. In Table B, under the heading of "Overall Efficiency Per Cent", he shows an efficiency of 70%. Now, the term "overall efficiency" is indicative to me of the use to which a given unit is to be put. Mr. Dash's generator requires ballast to operate, to ultimately fulfill its purpose; yet ballast losses are omitted. The misleading character of this figure becomes apparent in the light of the fact that the 70% efficiency figure cited by Mr. Dash becomes only 45% when the ballast necessary to operate his device is included!

I have not seen a copy of Mr. Smith's paper presented before the S.M.P.E., but I was present when it was delivered. Consideration of copper-oxide rectifier efficiency can be undertaken when the Society releases the aforementioned paper. However, I consider Mr. Smith a very able engineer and am perfectly willing to accept his answer on copper-oxide rectifier efficiency. Assuming that Mr. Smith did place this figure at 65%, this still is several miles ahead of generator efficiency for the same job.

With respect to the removal of rectifiers because of power line fluctuations, I, too, have heard of similar cases. We rectifier people never claimed that our product would serve as an automatic voltage regulator or would correct a serious fault of the power house. However, any utility subscriber that endures a line so variable in voltage supply that he cannot use a rectifier with perfect satisfaction, needs a brain specialist and not a generator.

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COLOR FILM REQUISITES

(*Continued from page* 12)

tions were almost childishly respondent. I recognized the artist's influence; except that instead of merely making an artistic choice of one of Nature's offerings, the subject was created by the artist. My ideas of color were fully satisfied. Furthermore, it seemed to prove that the system was capable of properly reproducing a good color scheme.

I experienced the same delight in viewing "Becky Sharpe"; and I refuse to be influenced by the "pastel patrons" or the "true to Nature" fanatics. I love pretty costumes and appropriately designed backgrounds. I like women dolled up and made up. I love *color.*

I recognized some technical difficulties such as matching the close-ups and long shots. But such errors are found in the best black-and-white pictures. This will be overcome when the technicians gradually realize that every change of light and variation in exposures means as great a variety of color values. This error in matching close-ups and long shots seems less noticeable on exteriors for the very reason that the cameramen cannot haul in Old Sol twenty-five million miles, or so nearer, when making the close-ups.

It must be realized that there are many subjects that, while not offering much in the way of color, are beautiful when rendered in black-and-white: This is because the features of that subject may be a striking light effect, a happy distribution of tones and other elements not particularly represented in the distribution of color values. Therefore, if I must choose between dingy reds, dusty greens, neutral grays, faded blues and other indifferent tones (as too frequently found in Nature) and the black-and-white, I'll take the latter.

But as there is no question but that the artistic cameraman can come to Nature's aid in the black-and-white, we can likewise hope for success in color photography by permitting the artist or color expert to contribute his peculiar training.

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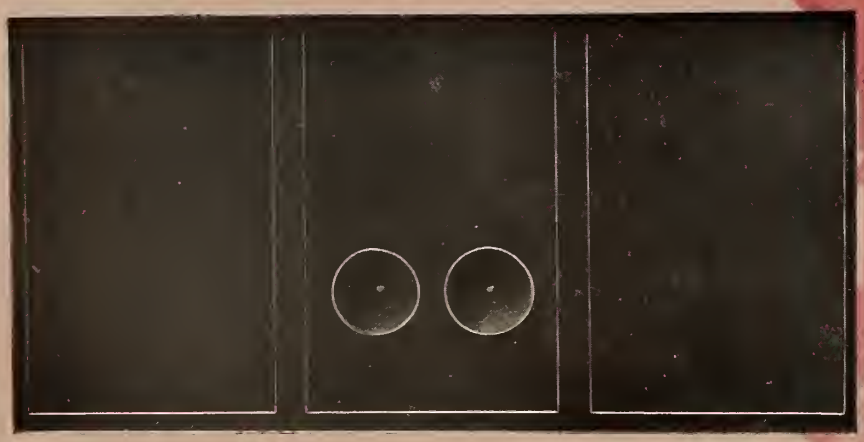
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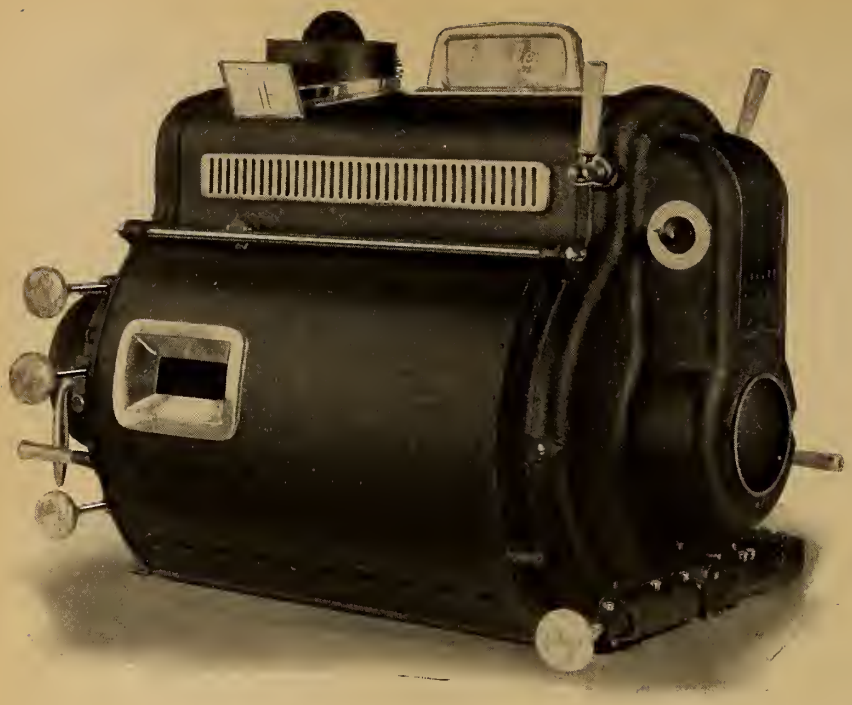
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Volume 11 JULY 1936 *Number 1*

Index and Monthly Chat 5

Speaker Development an Index to Advances in the Sound-Picture Art 7
AARON NADELL

"Three-Dimensional" Movies by the Polaroid System 12
GEORGE WHEELWRIGHT

Background Process Projector 13
HERBERT GRIFFIN

Color, Recording Gains Cited in S.M.P.E. Progress Report .. 14

Novel Optical System Modifies RCA Soundhead for Push-Pull Track 15
SERVICE DEPT., RCA MFG. CO.

That Old Refrain: Projectionist Incompetency 16

Tubes the First Suspect When an Amplifier Fails 17
A. C. SCHROEDER

Observations 18
JAMES J. FINN

New W. E. 300A Power Tube Replaces 242A in 43A Amplifier 20
J. O. McNALLY

Sarnoff, RCA Head, Discusses Television Possibilities 21

News of the Month 22

News Notes
Technical Hints
Miscellaneous Items

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MONTHLY CHAT

MANY and varied are the services rendered by I. P.'s Service Dept., and readers are frequently invited to avail themselves of these facilities. However, there must necessarily be imposed some restrictions upon the scope of such activities—such as, for example, the preparation for individual readers of material which will provide the basis for fifteen- or thirty-minute talks before the local Rotary Club, Chamber of Commerce, or what has one.

I. P.'s deep interest in the historical aspects of the sound picture art is unquestionable; but its present facilities unfortunately prevent it lending more than moral support to this worthy endeavor. Such requests by an organization would, of course, be honored; but too little time is available after grubbing for technical data to prepare such propaganda for individuals.

SO INTENT are labor organizations on obtaining the best possible wages and working conditions that, it seems, they can think of nothing else—and particularly not about by-products of their daily work which ultimately exert a profound influence on the aforementioned wages and conditions. Imagine even a dinky business organization that did not keep up-to-date records on the state of the industry in which it was engaged. More about this herein.

CONSTANT pounding having disposed of the majority of fakers promotion "television in thirty days" and three-dimensional motion pictures by means of "this marvelous little attachment," the current phobia of projectionists is the much-discussed but little-known "cold light," as the new mercury-vapor lamps are commonly termed. This "cold light," it may interest all and sundry, still is very cold as a practical projection adjunct; and when it finally does get "hot" the studios will have the first whack at it.

With so many current pressing problems to consider (one might clean a lens occasionally) it's funny how projection people ceaselessly hunt for new headaches. They insist upon knowing what is likely to happen three years from now, but they can't hardly ever take time to make a good job out of projection right now.

THAT 6L6 tube story last month (p. 22) was a pip, and one that offered John Projectionist a gorgeous opportunity to hit the boss smack between the eyes with a new twist. I. P. cherishes these scoops of the exhibitor and semi-technical papers only because it offers its readers a chance to pack away nice chunks of prestige in the ice-box. The minute you grab anything new, hot-foot it to the boss and lay it on the line. It will pay dividends to both the individual and organization. Even if, as is likely, the boss is too busy complaining about poor business to do anything about it.

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VOLUME XI NUMBER 1

JULY 1936

Speaker Development An Index to Advances in Sound-Picture Art

By AARON NADELL

THE complex loud speaker systems used in many theatres today stem from simple beginnings. One of the earliest methods of solving the sound-picture speaker problem was to use a number of dynamic units of the familiar radio type, placed flush with, and all around the rim of, the screen, between the lighted portion and the masking. The fact that the screen was surrounded by speakers on every side produced the impression that the sound heard came from somewhere in the center of the picture, and created a satisfactory illusion of identity between the player and the reproduced voice.

Very satisfactory results, for those days, were obtained in laboratories, review rooms, and sales demonstrations. When the same method was transported to the theatre, however, it was often found that sound in the front seats was too loud, or in the back seats not loud enough, and that acoustic difficulties of other kinds could not even be attacked, because the speaker arrangements had no flexibility.

The most successful sound systems of early days used a very different form of approach to the speaker direction—namely, the familiar electro-dynamic "unit" mounted at the base of an exponential horn. With this apparatus, and a suitable number of horns (or exponential baffles, as very similar-looking structures came to be called later on) it was possible to point some of the sound over the heads of the audience in the front seats, and project it toward the rear of the house. The placement of such speakers was, in fact, developed to a very high degree that produced even sound level, within 3 db, in every part of the auditorium. Moreover, such speakers could be placed and pointed to correct acoustic defects, as by keeping sound away from a source of echo or of excessive reverberation, or to reinforce a "dead spot" by bouncing sound off a neighboring wall. The most common dead spots, those at the extreme front corners of the theatre, were often "brought to life" by crossing the beams of sound—pointing the left-hand speaker to supply the right-front corner, and the right-hand speaker to supply the left-front corner. There are theatres in which this method still is in use.

The horn, or exponential baffle, however, needed a wide opening to enable it to reproduce the lower sound frequencies, and could not as a practical procedure be placed around the edges of the screen. Neither space nor cost permitted the use of that method of obtaining natural illusion. Sometimes horns were placed below the screen, perhaps in the orchestra pit, and also hung above it, but the distances separating the sources of sound from the apparent sources in the picture invariably spoiled the illusion, especially in the favored front seats. Hence, the porous or perforated "sound screen" became neces-

sary, and in spite of the loss of light entailed by its use, remains in universal favor today.

Illusion vs. Distribution

Thus, two conflicting requirements relating to theatre speakers were met by adoption of a compromise medium in the form of a special screen. Those requirements were: placement for good illusion, and good distribution of sound. Four other speaker requirements have contributed to the development of theatre acoustic systems down to the present day, listed as follows:

1. Reliable and convenient field power supplies.
2. Flexible and adequate voice supply controls.
3. Enlarged frequency response.
4. Enlarged volume response.

Some of these requirements interlock and call for compromise solutions; some, such as field supply, stand alone.

Thus, there has been change since the earliest days in the solution then found to the question of securing proper illusion, but the advantage of the horn (or trumpet, or directional baffle) from the point of view of good distribution has been challenged by the desire for a wider frequency response than any single horn could be expected to give. Some picture houses have abandoned horns entirely; in others they are used for some frequencies but not for all. Under ideal conditions the acoustics of the theatre determine the proper point of compromise between the best possible distribution and the best possible frequency response; but not all theatres enjoy ideal installation conditions, and in many both distribution and frequency response are extremely bad.

The frequency range of any horn is limited. The very low notes cannot be reproduced without a wide orifice which, in an exponential horn, calls for impossibly great length. Horns capable of dealing faithfully with even fairly low-pitched sounds almost always have a sharp cut-off below the upper frequencies demanded by modern standards. Within the limits of frequency imposed by its nature, the horn or directional baffle remains invaluable for securing good distribution and for dealing with acoustic faults of the theatre itself, and it is often used in modern installations to reproduce the middle band of frequencies, the upper and lower extremes being reproduced by other speakers.

The very low notes are often reproduced by electro-dynamic speakers of the standard radio type, but more powerful than most radio speakers. These are equipped with flat baffles, or acoustic labyrinths, to enhance reproduction of the lows. Standing in front of a dynamic speaker, place a string at the edge of the diaphragm and run it around the baffle board, or around the edge of any cabinet in which the speaker may be mounted, until it touches the back of the diaphragm. The length of the string, as thus run, determines the frequency of the lowest note that will be reproduced. The simplest form of acoustic labyrinth is the arrangement diagrammed in Fig. 1, in which the string length or air path between the front and back of the speaker has been made very long. Modified forms of this arrangement are offered by different manufacturers, including some in which the speaker is so baffled that it cannot reproduce any except very low notes.

Dynamic speakers so mounted cannot easily be adjusted for best distribution. The sound from them simply spills around the auditorium. Low-frequency sounds do not tend to travel in beams, as they equalize themselves fairly well; but flat baffles allow little chance of keeping them away from echo points or reverberant surfaces. One manufacturer mounts dynamic speakers in metal recesses that can be adjusted to secure a moderate degree of distribution control.

High-Frequency Distribution

High-frequency sounds tend to travel in beams. They are reproduced in the theatre by small speakers, some of crystal type, equipped with correspondingly small horns. They add to the general body of sound high-frequency tones that cannot be reproduced by the ordinary dynamic, and if enough of them are used, good high frequency distribution can be obtained. It is very seldom that enough of them are used to keep sound in all seats as excellently crisp as it is in some. In this matter the best possible distribution, so far as the higher frequencies are concerned, must compromise with economic possibilities. For truly ideal results, dozens of high frequency tweeters might be needed in some theatres. Some sound systems recently developed, but not as yet generally introduced, use multiple horns in which a dozen or more high frequency openings radiate from a central chamber against which the speaker unit operates.

In the matter of frequency response, theatre speaker systems appear to be still in process of development, and speaker arrangements in actual use today vary from a single dynamic on a flat baffle to multiple systems in which separate speakers or banks of speakers are devoted to reproduction of as many as three different bands of sound, and equipped with all possible combinations of short trumpets, long trumpets, flat baffles or acoustic labyrinths.

These different speaker arrangements call for a similarly wide range of voice supply controls, but do not eliminate the fundamental problem of voice controls, which has been present since the first theatre systems were installed—namely, a method of matching the output impedance of a standard amplifier to any number of speakers that might be used in accordance with individual acoustic requirements. Some form of tapped transformer or auto-transformer has always constituted the answer to that question. One very widely used matching panel, consisting of auto-transformer and tap switches, offered as many as 84 possible impedance combinations, and could be set to provide acceptable compromise between the requirements of good impedance match and of varying volume from different speakers as called for by considerations of good distribution. In the very early days of sound pictures, such panels were used in association with two different types of horns, designated as "bass" and "tenor" horns, although the difference between them was one of approximately only ten cycles per second. Volume to bass and tenor speakers could be controlled separately, still maintaining acceptable impedance match and distribution, by means of those flexible matching panels. They are now obsolete, however, and not supplied with new systems, although still in use in many theatres.

Simple Impedance Match

The simplest method of securing impedance match in use today is provision of a tapped output transformer in the amplifier, offering a selection of output impedances. The speakers are connected in series, parallel, or series-

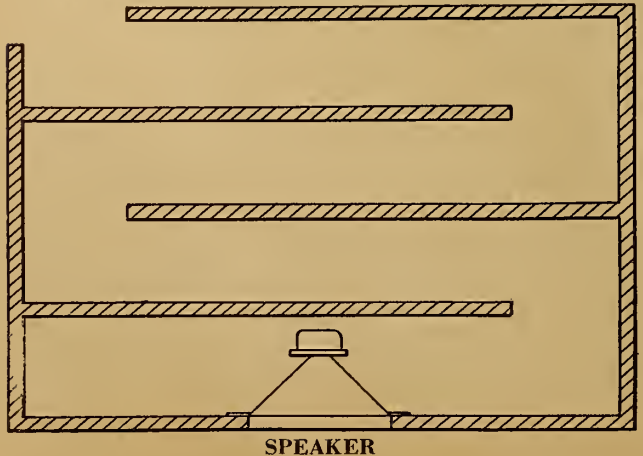


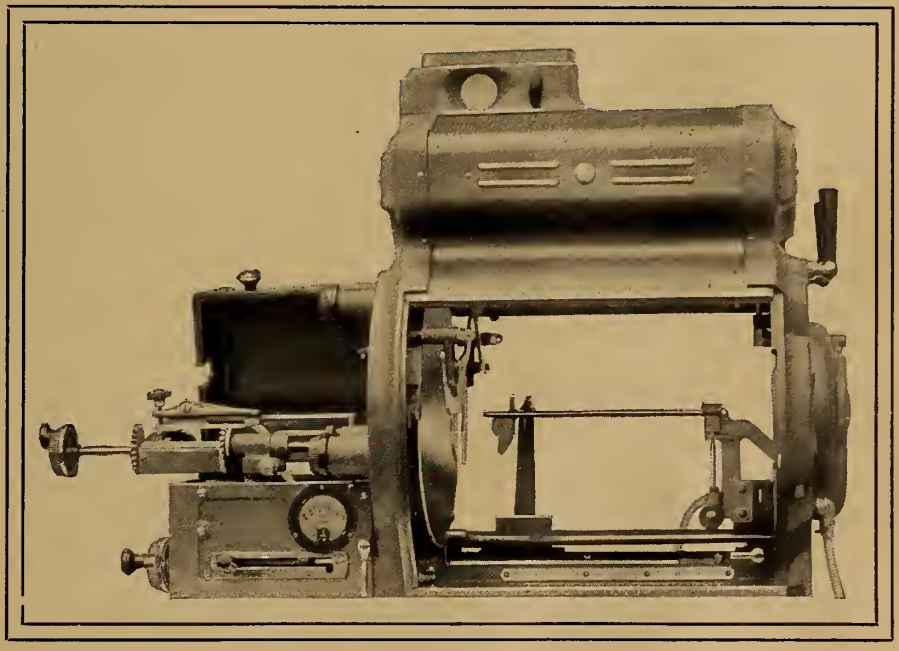
FIGURE 1

Acoustic labyrinth for the reproduction of extreme low frequencies

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parallel, to match some one of the output impedances offered by the amplifier. If control of individual speaker volume is desired (which is almost always true of the monitor, even if not of the stage units) L pads, T pads or simple potentiometers are connected in the speaker circuits.

Where separate speakers or groups of speakers reproduce selected bands of frequencies there are two general methods of control. One is the introduction of electrical filters in the speaker circuits —tuned arrangements of inductances, resistances and condensers, that offer different impedances to different bands of frequencies, and so detour each group of frequencies into those speakers that will handle them most efficiently. The one exception to this principle is when a high-impedance tweeter, such as a crystal, is used in association with a standard dynamic. In that case no electrical filter is necessary, the crystal by its nature offering an almost infinite impedance to all frequencies it is not capable of reproducing, although its response is somewhat reduced by lack of those high frequencies that pass through the parallel path of the dynamic.

When both high and low frequency speakers are of the dynamic type, filter networks are customarily employed. The networks should, of course, match the output impedance of the amplifier and the input impedance of the speaker combinations they serve.

Another and different method eliminates the networks by using identical types of dynamic speakers in frequency-discriminating baffles. Thus, one bank of dynamics may be mounted in acoustic labyrinths that will reproduce low frequencies only, while another set of the same speakers are made to play through short directional baffles that do well by the medium and high frequencies but will not reproduce the lows.

The relative response from each group of speakers may be altered by changing the frequency response of the amplifier. This may be done by connecting or open-circuiting condensers installed in the amplifier for that purpose, or by adjusting a tone control dial; the frequency response in either case being modified to suit auditorium acoustics.

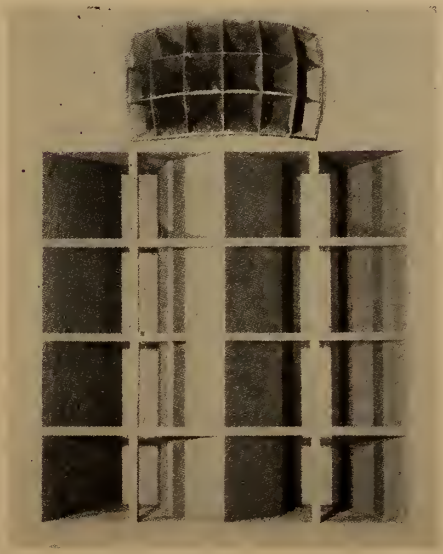
Speaker Field Supply Changes

Methods of providing speaker field excitation have undergone drastic revision since the early days in which the two standard sources of field power were storage batteries and motor generators. Both are definitely obsolete, although generators, at least, are still used and giving good service in many theatres. Storage batteries were first replaced by drawing on the d. c. arc supply, and then by installing rectifiers designed for the purpose, and sometimes by installing motor-generators. Rectifiers still are used. A. C. speakers, in which each electro-dynamic unit mounts its own rectifier, are increasingly popular.

Some systems follow the radio receiver practice of using speaker fields designed for high voltage and low current, rather than the reverse as in earlier models, and incorporating the speaker fields in the amplifier filter circuit. This practice, however, necessitates carrying relatively high voltage from the projection room to the screen and back again, and in some communities involves difficulty with local building and fire codes.

Old Magnetic Type Returns

There has been a strong revival of the old magnetic speaker, in the form of the "permanent magnet dynamic"—that is, a unit designed on the lines of a dynamic speaker with a moving voice coil of low impedance instead of a fixed speech coil of high impedance, but deriving its field from a metal magnet instead of an electro-dynamic winding. These speakers have been made practical by the development of new magnetic alloys. Nickel and sometimes aluminum play prominent parts in these alloys, which have greater magnetic power than any previously known, and make possible permanent-magnet speakers capable of the volume of electro-dynamics. Such speakers have not at this writing been widely used behind the screen, but the less powerful forms are winning increasing favor as monitors. At this time large permanent magnet dynamics are more costly than electro-dynamics of equal power-handling capacity, but cheaper in the case of a new sound installation, inasmuch as their use completely eliminates the need for field power supplies and reduces the number of wires that must be run backstage from the projection room.



Modern multi-cellular folded horn assembly, for both low- and high-frequency reproduction. Contrast this with early types of speakers

The speaker characteristics thus far considered include placement for illusion, distribution of sound, frequency response, voice supply controls, and field supplies. Volume response remains to be considered.

Modern installations are capable of greater volume range than was formerly the case, although this result has, as often as not, been obtained by increasing the number of speakers, rather than improving the power-handling capacity of individual units. In fact, power-handling capacity per unit has shown a tendency to decline, especially insofar as highly efficient dynamic units closely coupled to efficient exponential horns have been replaced by radio types of speakers, in which the baffling does not provide equally effective transfer of energy between cone and air.

Amplifier Power Increase

But the illusion of natural sound requires that the volume range of the original, as well as the frequency range, shall be reproduced as faithfully as technical considerations allow. There is no sound system in commercial use today that will equal the volume range of a good orchestra, let alone of thunder or of traffic noises in a large city. That goal, however, is being approached by increase of amplifier power; and another advance may be made in the near future by addition of volume expansion circuits to compensate for the volume limitations of the sound track.

There is thus a definite tendency on the part of manufacturers to recommend and supply more speakers, which, even if less efficient, are more powerful. The difference in efficiency can easily be made up by increasing the power output of the amplifier, which is now an inexpensive procedure.

Two Types of Light Glare: 'Discomfort' and 'Blinding'

The term "glare" is not, in its origin, a scientific term. In proper usage it is undiscriminatingly applied to the ocular discomfort which one experiences in the presence of a brilliant light source and to the decrease in the observer's capacity to see resulting from the blinding influence of the light source. Careful scientific research has positively established that discomfort glare and blinding glare are two distinct and separable phenomena, produced by distinct and separable characteristics of the glare source.

Discomfort glare is a product of the intrinsic brightness of the glare source and of the contrast between that glare source and its background. Blinding glare is a product of the total candlepower emission of the glare source in the direction of the eye and of the angle which the glare beam makes with the line of vision.

'Three-Dimensional' Movies By The Polaroid System

By GEORGE WHEELWRIGHT

THE LAND-WHEELWRIGHT LABORATORIES, INC., BOSTON, MASS.

FOREWORD: Polaroid is the trade name for a material which polarizes light, and is the invention of Edwin H. Land. Briefly stated, Polaroid is a grouping of a great many minute crystals, on a matrix layer, having the effect of a single large crystal in influencing the vibrations in a light wave. Polaroid, now handled by Eastman, is an invaluable aid in amateur and professional photography, completely eliminating glare.

Polaroid motion pictures involve the taking of two simultaneous pictures, complimentary to each eye. In a demonstration before the Atlantic Coast Section of the S. M. P. E., projection was accomplished by means of two reels of 16 mm. film which were run on two interlocked projectors, the two views being projected to the same screen, one over the other. Eye-compensating accessories—analyzers known as Polaroid glasses—are necessary for viewing the pictures.

The application of the Polaroid system to the taking and showing of relief pictures appeals to this reviewer as infinitely more interesting as an adventure in science than as a substantial contribution to the commercial advancement of the art. That it constitutes any logical approach to the problem of real, as contrasted with pseudo, three-dimensional motion pictures is extremely doubtful—because of the necessity for using the aforementioned analyzers, the bugaboo of all 'three-dimensional' forays to date. Polaroid certainly constitutes a great advancement over other 'three-dimensional' systems, notably the Audio-Scopics distributed recently by M-G-M; but this fact in itself does not enhance the commercial status of the system.

Somehow, somewhere in the experimental chain which undoubtedly is being forged about Polaroid may lie the answer to full realization of that which today still is the dream of three-dimensional motion pictures, and it is this possibility which lends importance to the development. As a practical approach to this vexing problem, however, the Polaroid system in its present stage of development serves only to lend buoyancy to the hope for ultimate success in this direction.—J.J.F.

THE feeling of reality, of actual presence at the scene of action, has been created and sold very effectively to the public by the movie industry for many years. This illusion of reality has been built up step by step. Starting with the still photograph, the industry gave the photograph motion. Let us say that this was the first step towards reproducing actual vision. Somewhat later, the industry took another step—and added sound. More recently, the industry added color.

Color, plus motion, plus the naturally accurate detail of the photograph, have added up to a total which approaches very close to the effect obtained by being on the scene of action and seeing what's going on with one's own eyes.

Only one thing has been lacking: the ability to reproduce in the theatre what the human eyes pick up during every minute of normal life outside the theatre —the third dimension, the impression of depth and roundness of things looked at.

Polaroid makes it possible to add this final step in the recreation of reality. For one-eyed vision, in motion pictures, it substitutes two-eyed vision.

Most of our present impressions of distance and of space arise from the fact that we see simultaneously with two eyes. The view seen by one eye is always slightly different from that seen by the other, simply because the two eyes do not coincide with each other. Through life-long experience, our brains are trained to interpret the minute differences between the two views in terms of space and distance.

Photography and Projection

In taking Polaroid three-dimensional movies, there is no change in the taking of the pictures, except that two simultaneous pictures are taken of the scene, eye-distance apart. The camera, to express it differently, looks at the scene just as a pair of human eyes would look at it.

In showing, the two views are projected on the same screen, one over the other. Each image is polarized by projection through Polaroid discs, set in such a way that the right-eye image, let us say, reaches the screen polarized vertically, while the left-eye image reaches the screen polarized horizontally.

The audience, *supplied with Polaroid glasses*, with the lenses set at corresponding angles, sees one image with the left eye, the other with the right; each eye sees one picture and one picture only. The process is complete: the left eye sees what the left eye would ordinarily see if it were present at the scene of action, and the right eye sees what it would see. The brain is free to convert these impressions into a feeling of depth and true realism. When you see the Polaroid movies, I believe you will agree that they are natural and complete. You will feel that the people are not simply visible on the screen but actually there in person, and that you could actually walk up and touch them.

This method of stereoscopic movie projection is free from the limitations of the red and green glasses with which we are all familiar. Thus we can now have colored movies with full third dimension. It is also free from the less obvious but equally troublesome difficulty of red and green glasses—the retinal rivalry between the eyes.

An interesting thing about Polaroid movies is that stereoscopy and color naturally go together. This is one place where the whole is greater than the sum of all its parts. Color for each eye is naturally slightly different, just as the viewpoint of each eye is slightly different. Highlights occur at different points for each of the eyes, and color tones also show a considerable variation, as you can tell by closing your eyes alternately in rapid succession and comparing the color impressions. The result is that we cannot expect to see color looking real until we have the two-eye pictures properly taken, with the not obvious, but nevertheless important, differences in highlights and color tones properly rendered.

It is expected that relatively inexpensive equipment for the taking and pro-

jection of Polaroid three-dimensional movies will be made available not only to professional but to amateur moviemakers in the very near future.

Light has two fundamental properties. The first of these is the *number* of vibrations per second, or color, as the layman knows it. The second fundamental property of light is the *direction* in which these vibrations occur. Unpolarized light vibrates in all directions to a plane at right angles to the direction of its travel. Plane-polarized light is so controlled that the vibrations all lie along a given line in this plane.

Specular Reflection Eliminated

These two fundamental properties of light have not been equally recognized by the general public due to the fact that while the *number* of vibrations per second is controllable through filters and other means, the second, the *direction* in which these vibrations may occur (or the polarization of light), has not been controllable by any practicable means.

Polaroid consists of a lamination of transparent material set between pieces of glass. The filling in the sandwich appears to be transparent; it forms a matrix for a great number of tiny crystals—so small that they cannot be seen under a high-powered microscope—all lined up side by side, so that they behave like a single large crystal. The effect of the Polaroid is to comb out the vibrations in a light wave, so that instead of vibrating helter-skelter at all possible planes at right angles to the direction of the light wave (the situation which exists in ordinary light) the vibrations are all straightened out and vibrating in planes parallel to each other.

The chief applications of Polaroid, as we can now forecast them, include three-dimensional movies, automobile headlights and windshields which will eliminate the present blinding glare and hazard in night driving; industrial inspection lights, which eliminate the reflection from highly polished surfaces; strain detectors for inspection of glass and for analyzing the strain in gears, beams and other structural parts, and a number of other applications in industry and science.

BACKGROUND PROCESS PROJECTOR

By *Herbert Griffin*

INTERNATIONAL PROJECTOR CORPORATION

Presented Before the Spring Meeting of the Society of Motion Picture Engineers

A NEW type of background projector for use in process photography in motion picture studios has been developed which has already been installed in studios in England, Sweden, Japan, and the United States. In appearance this equipment is quite similar to the well known Super-Simplex projector, but the mechanism, magazines, and lamp house are mounted upon a specially built, rigid pedestal assembly in order to eliminate the possibility of vibration during operation (Fig. 1).

The complete unit is composed of a specially constructed Super Simplex mechanism, the usual upper and lower magazines, and a Hall & Connolly super-high-intensity lamp and lamp house, all mounted upon the above-mentioned pedestal. The projector mechanism is built especially for the work it must do, and commercial tolerances acceptable for theatre projection are eliminated in the construction of the process projector. The film-trap, for instance, is very accurately constructed, and is equipped with edge-guiding means in order that the picture may be absolutely steady laterally, and provision is made in the film-trap design and construction for judging the projected picture to determine what causes any unsteadiness that might be present.

For example, with this equipment it is possible to project a sprocket hole in the film, and if the perforations in the film are accurate—and they usually are—the image of the sprocket hole upon the screen is absolutely steady, both laterally and vertically. If the negative is projected and the camera frame line moves with relation to the perforation, that is a definite indication that the camera movement is not steady. If the positive is projected and the positive frame line moves with relation to the sprocket holes, that is a definite indication that the camera or the printer was unsteady; so that it is possible to observe and analyze satisfactorily any defect that may be present in the master print for process projection and thus eliminate endless discussion as to where the fault resides.

The intermittent movement of this particular equipment is of the Geneva type. It is manufactured to practically zero tolerance, and steadiness of the movement is carefully checked with a special test-film.

The mechanism may be easily lubricated without opening any of the mechanism doors. The bearings are fed through oil-tubes reached from the top of the mechanism, with the exception of the bearing for the intermittent movement, the oil-tube for which may be seen through a hole in the door on the non-operating side of the mechanism at a certain position of the framing device.

The lower section of the upper door on the non-operating side of the mechanism has been removed, thus making it possible to remove the door after removing the hinge screws. Thus it is possible to get into the non-operating side of the mechanism should it become necessary to do so. The lower door section may be removed in the same manner. A grease cup is provided for lubricating the rear shutter shaft, a single turn of which suffices to force sufficient lubrication into the ball bearing. A special lubricant has been developed for this purpose.

No motors are supplied as part of the equipment, because various types of motors are used throughout the world for interlocking systems. A kind of motor used on the customer's particular type

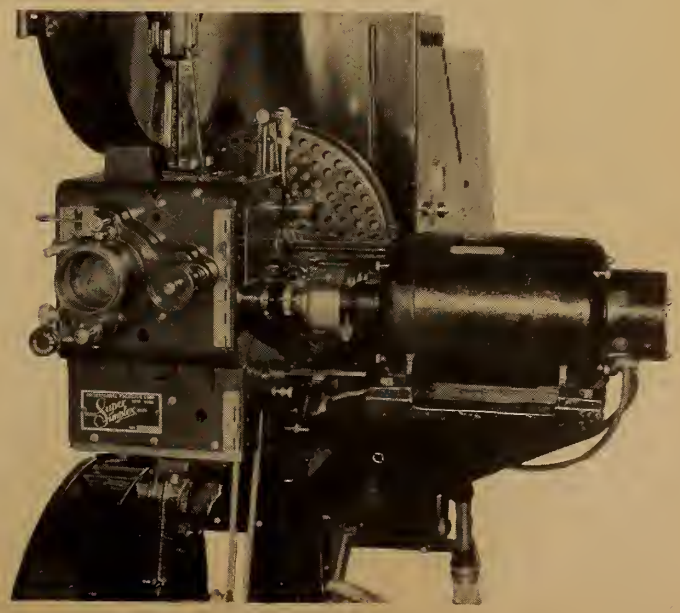


FIGURE 1

Background process projector, showing pedestal assembly

of interlocking system is furnished to the projector manufacturer, and a special motor table is then designed and built and rigidly attached to the projector stand in such a position that the motor shaft is coupled directly to the drive shaft of the intermittent movement. Lost motion is therefore eliminated between the camera shutter and the projector shutter, since no gear train is involved in this form of design.

The intermittent movement of the projector, as is the case with the camera, when properly interlocked operates at 1440 frames per minute — standard photographing and sound recording speed. Adequate provision is made to adjust the projector and camera movements to the interlocking motor system. The coupling flange on the intermittent movement is so designed that it may be secured to the shaft in any position. It is necessary only to open two clamping screws, rotate either the motor or the intermittent movement shaft while the one or the other is standing, and clamp the flange tightly again after the proper position is attained in synchronism with the camera shutter movement.

'Hot Spots,' Single-Blade Shutter

As in the case of regular projection room practice, it is necessary to adjust the lamp house to its correct position with relation to the aperture plate of the projector, to see that the special condensing system is in its proper relative position, and that the arc is burning at its proper capacity in order to clear up the entire screen and attain satisfactory and uniformly distributed screen illumination. If a "hot spot" occurs at the center of the screen, it is possible to remove it by mounting a small circular disk cut from fine copper mesh exactly in the center of the light-beam at the proper point in front of the lens. Experiment will definitely determine the distances required with lenses of different focal lengths.

There is, of course, very noticeable flicker upon the screen when using this type of projector, due to the single-bladed shutter that is used, so that it should not be used for normal projection of motion pictures. It is purely for process work, and, naturally, flicker is not noticeable to the synchronized camera under such circumstances. Should it be required to project standard motion pictures with this equipment, the shutter must be removed and the standard two-bladed shutter substituted. The equipment, of course, must be carefully handled, due to its extreme accuracy.

More than 3000 copies of "Sound Picture Circuits" sold to date. Step-by-step analysis of all circuits, with illustrations separate, providing constant ready reference. Order your copy now from I.P. for $1.75, postage prepaid.--Adv.

COLOR, RECORDING GAINS CITED IN S. M. P. E. PROGRESS REPORT

COLOR photography made great strides during the year with the introduction of Kodachrome in the amateur field and the extensive use of Technicolor in feature productions. The long-awaited silent camera seemed to come nearer in 1935, and descriptions of new silent and nearly silent cameras are contained in the appended report.

Another item of interest partially developed during the year is the new high-pressure air-cooled and water-cooled mercury arcs which threatened to revolutionize the art of stage and screen lighting, and incidentally offered a new tool for recording sound. It is to be expected that considerable progress will be made by the various branches of cinematography in adopting these arcs during 1936.

In the field of sound recording, considerable progress is to be noted during the year just closed. Push-pull recording gained a strong foothold in Hollywood and promises to play an important part in studio production work during the coming year. Invalidation of the Tri-Ergon patents has led to the development of new sound reproducing systems utilizing principles previously barred by the claims of the now defunct patents. Advancement in sound reproduction was made during the year with the introduction of the new multicellular, or Fletcher, type of horn.

Film and Emulsions.—The introduction of Kodachrome film in April, 1935, marked one of the greatest achievements of the emulsion manufacturer and research chemist. Although available only in 16-mm. width, the significance of the emulsion makers' skill is nevertheless supreme, because this product requires no less than five separate coatings besides the anti-halo coatings upon the back. During reversal development, the silver image in each emulsion is transformed into a dye image complementary in color to the color to which the emulsion was sensitive. The high sensitivity of the emulsions, necessitating only a slight increase of exposure over that required for ordinary photography, is another useful property of this new color process.

New Silent Camera—Fox

Besides this noteworthy contribution in the field of color, further improvement in negative emulsions was evidenced by the introduction of still greater speed than had been available before 1935. These new materials of satisfactory color-sensitivity and low graininess quickly found application both in the studio and for news photography under poor lighting conditions.

Cameras and Accessories.—Perhaps this year's most interesting announcement in professional camera design was made by the technical staff of Twentieth Century-Fox. The general layout of the camera adheres essentially to conventional American practice; that is, a four-lens turrret is used, a durable metal box houses the camera mechanism itself and is surmounted by a dual external film magazine of 1000-ft. capacity, while the driving motor is mounted at the rear. Access to the mechanism is through a door on the left-hand side, at which side is mounted also a finder interlocked with the focusing mechanism.

Silence is achieved by uniformity of action of the movement, by reducing the amount of gearing and the weight of the moving parts, and by giving to the film as free a path as possible. Magazine noise is minimized by affording the film free passage, and by eliminating contact between the edges of the film and the walls of the magazine. Provision has been made for using a variety of standard driving motors. The mounting of the finder is of the conventional form, interlocking with the lens-focusing mechanism to correct for focus and parallax. Parallax compensation is provided by a lateral movement of the finder lens which may be roughly compared to the sliding front board of a still camera.

A new camera for the three-color Technicolor process has a double film-gate at right angles. At one aperture a supersensitive film for the green negative is photographed; at the other, a bi-pack photographic record is taken, the red-sensitive negative being back of a blue-sensitive film.

Technicolor Optical System

The optical system consists of a specially designed photographic objective and a beam-splitting prism. The filtering action for color-selectivity is provided by suitable green and magenta filters. With regard to outside appearance, the camera is designed upon conventional lines. Provisions have been made for perfect registration of the images and for critical focusing.

The new Mitchell studio camera was designed to meet the needs of the present sound stages for a silent, lightweight, compact, and convenient camera. The most significant changes are the addition of an automatic dissolve, and

(*Continued on page* 22)

Novel Optical System Modifies RCA Soundhead for Push-Pull Track

DATA SUPPLIED BY THE SERVICE DEPARTMENT, RCA MANUFACTURING COMPANY

Important changes in soundhead optical systems are now being effected by RCA so that theatre audiences may obtain the benefits of push-pull recording. These changes are detailed in the accompanying article, which is an abstract from the actual field service notes. These data, and the illustrations, are published herein for the first time anywhere.—*Editor.*

IN THE discussion on the various types of RCA sound recording on film, the advantages of using a push-pull track are brought out. A push-pull track, however, requires a push-pull take-off system for the reproducer; and accordingly the MI-1040 soundhead has been modified to permit reproduction of either standard track or push-pull track. The modified head is known as MI-1070. Preparations for converting the PS24 head in the field for push-pull operation are in progress.

Reproduction of the push-pull track is made possible in the MI-1070 soundhead by the use of a very interesting train of optical units, as illustrated in Fig. 1. The light from the exciter lamp is focussed on to the sound track in the usual manner. After it passes through the film, the light is picked up by a lens which is flat on one side and cylindrical on the other. This cylindrical lens is mounted with its axis vertical and serves to magnify the image of the sound track beam laterally, but does not change the size of the beam along the length of the film. This spreading of the light laterally facilitates the separation of the two tracks at a later point in the optical train.

After leaving the cylindrical lens the light enters a convex condensing lens and is passed on to a double prism. This double right-angle prism was originally made up of two separate prisms cemented together as shown in the sketch. Production models will have a double prism cut from a single piece of glass.

The double prism is used to direct the light, first, outward toward the observer and then upward to a single prism. The single prism then gives the light another right-angle turn toward two cylindrical lenses cemented to the vertical face of the single prism. At this point the light from the two halves of the sound track are separated and bent so as to fall on the *upper* and *lower* cathodes of the RCA-920 push-pull photocell. Inasmuch as the push-pull track is printed with the two half tracks separated by .006", it is a fairly simple matter to set up the optical units so as to give a definite separation of the two tracks even if a slight amount of film weave occurs.

From the push-pull photocell the two opposite impulses are conveyed electrically to a special photocell transformer arranged for push-pull input, as shown in Fig. 2. The production models of the push-pull soundhead will include a switch to reconnect this circuit for reproduction of standard track. This reconnection consists simply of tieing the two photo-cell cathodes together and shifting the ground on the primary of the transformer from the centre tap to the lower end, as shown in Fig. 3.

The adjustment of the push-pull optical train is somewhat more lengthy than for a standard optical system, but is not in the least complicated. The first adjustment consists, of course, in setting the exciter lamp to the proper height. This adjustment can be readily checked by placing a white card in front of the first lens in the prism assembly and centering the filament image in the circle of light, as usual.

The second adjustment consists of

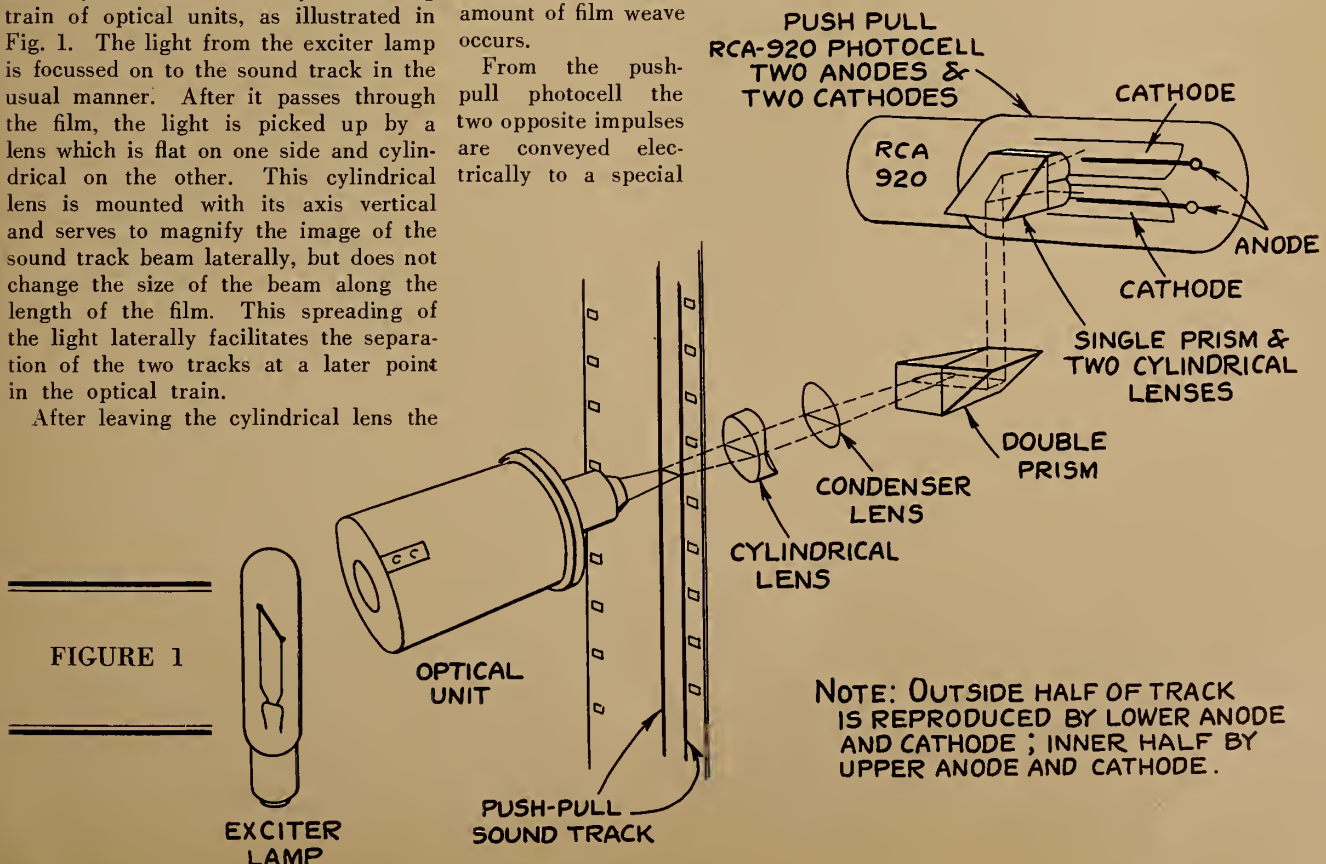


FIGURE 1

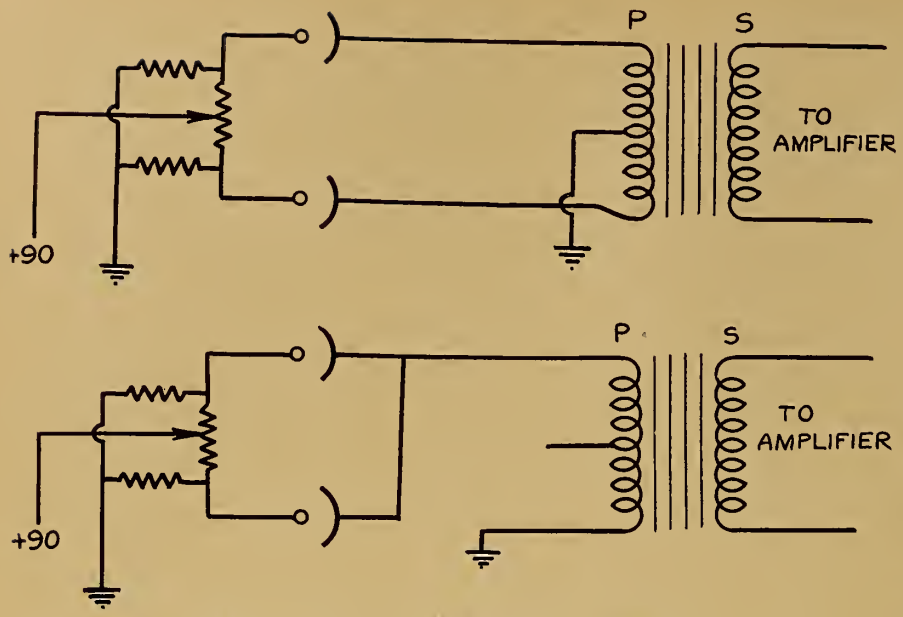


Figure 2 (above): "Push-Pull" connection
Figure 3 (below): "Standard" connection

lining up the prism assembly laterally with respect to the main optical barrel with no film in the machine. Two screws are provided on the base of the prism assembly so as to permit the assembly to be shifted toward or away from the observer. Correct adjustment is obtained by removing the photocell and placing a piece of translucent paper across over the two cylindrical lenses at the top of the prism assembly. The assembly is then shifted in and out until equal light areas are observed on the paper. When this condition is obtained, we are assured that the prism assembly is accurately aligned with the beams from the optical barrel.

The third adjustment consists of the usual focussing operation. With the "push-pull-standard" switch in "standard" position, 9000-cycle film is run through the machine and the optical barrel is focussed for maximum output.

Setting Lateral Guide Rollers

The fourth adjustment consists of setting the lateral guide rollers so as to position the film properly with respect to the beam from the optical barrel. This adjustment is most readily accomplished by again placing translucent paper over the two cylindrical lenses and then running a low-frequency record, perhaps 150-cycles, or a musical record through the machine. The guide rollers are then shifted in and out until equal areas of light are obtained on the two cylindrical lenses. As there is always some weave present, this setting will, of course, be determined by the average position of the two images on the paper while the film is running through.

To make the fifth adjustment, stop the machine and leave the low-frequency film threaded up. Turn the machine down by hand until a portion of the sound track is reached where the track is narrowest, as observed on translucent paper in front of the cylindrical lenses. At this point loosen the single screw provided and shift the lower portion of the prism assembly toward and away from the film until the image of the sound track is most sharply focussed on the translucent paper.

This latter adjustment is made in order to get the cylindrical lenses set at a point where the beams of light from the two halves of the sound track are not crossing. Any other position will allow some of the light from one-half of the track to be directed toward the portion of the photocell which is reproducing the other half of the track, with the result that the ouput is reduced and distortion introduced.

The final adjustment consists of balancing two halves of the photocell for equal output. This is accomplished by running any standard track (except unilateral variable area) through the machine and, with the switch in "push-pull" position, adjusting the photocell polarizing voltage potentiometer for minimum output.

That Old Refrain: Projectionist Competency

IT SEEMS that no discussion of technical matters among exhibitors or "engineers" is complete until pointed reference is made to projectionist shortcomings. No matter how involved be the topic under discussion, or what its ramifications, all other points are glossed over and left hanging in mid-air, so to speak, in the rush to indict the projectionist on a number of counts bearing chiefly on his incompetency, his shiftlessness and general all-around cussedness in blocking progress.

All this was unveiled for the writer at several exhibitor gatherings to which he was invited recently. Incidentally, these meetings ended on a slightly different note than usual, the result of the inability of the writer to swallow this indigestible mass of rot and remain silent.

Projectionist competency is often the topic of impassioned appeals herein for better work, continual study and a keener appreciation of duty on the part of projectionists. One of the chief functions of this publication is to keep its readers on their toes in this respect, the while it keeps them posted on new equipment and advanced technique. Projectionists get this service at their own expense in time and money, which is sufficient evidence, we think, of the desire of at least 7,000 craftsmen to keep abreast of the parade of progress.

Competency Only One Factor

Projectionist competency is only one factor in efficient reproduction, the astonished exhibitors were told in rather rough fashion by the writer. Granted that all the exhibitors present had the most competent projectionists in the world, the reproduction process can be only as satisfactory as the room equipment permits. The first requisite for improving the projection process, said the writer, was for exhibitors to take a little time off from their favorite pastime of projectionist-baiting and get a little education themselves anent the projection process.

First, exhibitors must learn to appreciate the fact that visual and sound projection equipment are not akin to concrete mixers, but are delicately-balanced mechanisms into the manufacture of which enter tolerances of the order of ten-thousandths of an inch! Nor is the projection process merely a matter of turning a knob or applying the requisite pressure on a change-over foot-switch.

The one sure-fire means of insuring good results, it was stated, was for the exhibitor to put the projection crew strictly on its own with respect to upkeep of room equipment and screen results. Thereafter, they might well devote their time and energy to the many other important aspects of theatre management. In short, they could mind their own business, particularly in moments of trouble when their frantic telephoning and visits to the room made matters much more complicated. This policy had been adopted by the writer with great success when he operated theatres, the exhibitors were told, although its successful execution demanded a bit more than merely a tolerant attitude. What, for example?

Well, the facts were contained in the corresponding files of I. P. in fulsome measure. Did the assembled exhibitor know, for instance, that in several units of a nationally-known exhibition chain moving parts of projector mechanisms

were taped! No, they didn't. Did they know that the bills they had paid, and likely were still paying, for damaged film were the result of their stupidity in refusing to order projector parts the cost of which was considerably under $5? Or that their dark screens and jumpy images were the result of penny-pinching replacement policies that were driving many dollars from their box-offices? Did they realize, also, the necessity for frequent projector overhauls? Did they know that deterioration of a projector mechanism was cumulative, and that a final repair bill of, say, $168 could have been settled for, say, $35 on a pay-as-you-go basis—for individual parts as needed? Did they realize the value of an ample stock of spares? Did they insist upon periodic inspection of equipment to detect probable breakdowns in advance? Did they encourage such inspection by providing proper tools and instruments?

Was it necessary, they were asked, for their projectionists to send downstairs notes such as the following:

"Dear Mr. Manager:

Your failure to act on repeated requests for overhauling of the projector heads forces us to inform you that from now on the projection crew will not be responsible for either screen quality or any accidents that may occur in the projection room or in the theatre as a result of failure of the projection process. *A copy of this note is being filed today at our Union headquarters.*"

This particular note got immediate results; but in the event that it had not, wouldn't it have been a pretty indictment of the management *just in case* the theatre in question had experienced a film fire (probable with such equipment) or a long breakdown? Nobody in the writer's audience answered.

Projection Is The Merchandise

It is all very well for exhibitors to install cooling systems (at cost ranging from $2,500 to $15,000) and comfortable chairs, and pretty decorations, and rich carpets and other modern conveniences. But exhibitors are selling none of these things, all of which are available in the home in varying degree. The theatre is selling motion picture entertainment, the exhibitors were informed, but it isn't saleable as merchandise until it is projected upon the screen and it positively isn't entertainment until it is *projected efficiently*. Efficient projection was possible only through efficient management, it was stated, a primary requisite of which was an intelligent attitude toward those factors which alone permit good projection.

Projectionist competency, indeed. In his opinion, said the writer, there is a great need in managerial ranks for education anent the basic essentials for good projection. Even assuming no great desire on the part of managers to add to their knowledge of showmanship, there still remains the vast dollars-and-cents difference on the annual cost operation sheet between an intelligent and a stupid policy with respect to the projection room.—J. J. FINN.

Tubes The First Suspect When Amplifier Fails

By A. C. SCHROEDER

MEMBER, PROJECTIONIST LOCAL UNION 150, LOS ANGELES, CALIF.

THE other night we noticed that the plate current on one of the '43 amplifiers was only 20 mils. Obviously something had happened which would require investigation, although there was nothing to worry about, as we have four 43's. When one of them goes out there is no mad rushing around and no wild scramble to get things done in a hurry.

Instead of working up a froth about it, the thought uppermost in my mind was whether to get at it immediately or to wait until the show was over, as it was almost closing time then.

The second line of thought was about what could have happened. Previous experience had taught me to think of tubes the first thing, no matter what it looks like. So I thought about tubes. Only 20 mils plate current, which meant, if it were the tubes, that either both amplifier tubes or both rectifier tubes had "gone West" at the same time, an improbable occurrence.

Having disposed of the tube situation for the time being—that is, in my thoughts—and neither of us having shown any signs of doing anything, I wondered what was the next most likely cause of such a condition. Ah! the condensers. But the trouble did not shape up as though a condenser had punctured. The plate current was steady at 20 mils; that was not like punctured condensers had acted before. True, the plate current had been low in other experiences of this sort, but it had not been so steady—the meter had been very much on the move, back and forth. Often a crackling noise is heard and many times a peculiar odor accompanies the phenomenon. None of these symptoms were present, so the condenser situation was disposed of again for the time being, and again in my mind only. Both of us still were very busy—thinking.

Other Trouble Possibilities

Now the thing began to look serious. Tubes and condensers are easy, but when one has to look beyond that, brain work might be required, and that's bad. We thought of the other possibilities: resistances, transformer windings, partly open bias resistors, etc. A happy thought! maybe the line voltage is low. No, the other amplifiers are O.K., so it can't be that. Oh, well, maybe it's in the line from the fuses to this particular amplifier, maybe a bad contact at the fuse. Well, now we have something that is no trouble to test, and we go into action.

Reaching for the test lamp, we know very well that we are kidding ourself, but then we *could* be on the right track. We make the test at the terminals on the back of the amplifier; the voltage is normal. Of course, the amplifier is not on, so there is no load on the circuit except the test lamps, which probably would not be enough to cause much drop in the line, even if there were trouble. We could turn on the amplifier, pushing in the door switch with our thumb, in order to draw normal current and thus cause the drop in the line. Meanwhile my assistant (excuse me, my chief) makes the test with the lamps. However, by this time we decide that we did not think that was the trouble anyway, so we let it go at that.

All action stops; and we again think about resistors and transformers. We take a mental inventory of the test apparatus in the room: buzzer and battery, test lamp, voltmeter. Maximum reading of the meter is 150 volts. Well, the meter is no good for use in the amplifier while it is turned on, as the voltages are too high. We think it over and decide that we do not care for makeshift testing anyway while the thing is "hot". Something like 1,000 volts is lurking around in there, ready to snap at us at the slightest provocation, or even without provocation.

There must be an easier way. Tubes and condensers naturally come to mind again, since they are easier to deal with. Maybe the condensers *could* act that way. We might disconnect the whole bank, both banks, and try the amplifier. That will either prove them guilty or it will eliminate them. A terrible thought comes to mind. Maybe it *will* eliminate them. Then it would mean getting back to the resistors and transformers. That pesky testing again, and so many things to check.

Now let's see. What does the circuit diagram look like? Two banks of condensers and a choke coil between them. We should determine just where the condenser leads are that have to be opened. We ought to look at the drawing in the cover of the amplifier, but that's too much trouble; the cover is in

(*Continued on next page, Col.* 1)

Observations . . .

By JAMES J. FINN

16 mm. Small-Town Invasion

Major producers are playing with the idea of employing portable 16 mm. sets to obtain representation in small towns which do not have a motion picture theatre. There's a lot of gunpowder inherent in this proposition. Labor's interest, of course, is immediately apparent. On the technical side, it is entirely possible to use a first-class portable equipment. with either incandescent or carbon arc illumination, and give a creditable performance with a 6 x 8 foot picture in a 400-seat auditorium where the acoustics are not bad.

But is this what will happen? Hardly. If we know our major producers, they will assemble outmoded equipment, run the prints to death, botch the reduction process (from 35 mm. to 16 mm.) select any old auditorium—a school, a church, or even a barn—irrespective of acoustics, and assign the set-up and operation of the equipment to the town nitwit. All of which will certainly make for economical operation, but nothing else. One picture in 17 will be intelligible enough to generate any further interest in motion pictures.

The possibilities of great loss of prestige accruing to the industry through such operating procedure is too apparent to require mention herein. Labor can be counted upon, of course, to grab a sizeable slice of this work, thus insuring some degree of projection competency; but majority of such showings will add up on the wrong side of the ledger for this business. Nothing that is set down here will have the slightest effect upon the producers' elected course, but it may prove useful as advance warning to projectionist organizations.

75% of Pictures Flop

Just what the double-feature madness is doing to the picture business (we can think of no other reason for such inefficiency) is put on view by the *Hollywood Reporter*: Out of 138 feature films released since Jan. 1 last, only 35, or 25% made a profit! Hollywood's business is the making of pictures, true, but not in the sense that a starving man in need of a loaf of bread should be given a bakery shop.

Thus the record of the Hollywood dynasty—a record of absorbing interest to those who merely work for a living at this business.

The A. F. of L. Tussle

The present clash of forces within the A. F. of L., representing the vertical and horizontal organization points of view, is strictly a battle for control of the Federation—no other interpretation being possible after watching the antics of both sides. Truth, honor, justice, liberty and all that hooey—yes, and including what form organization shall pursue—are not even remotely involved in the present tussle. "Organization form" is merely a phrase used to cloak the real motives of both sides in the struggle for control.

Coming close to home, there is no question but that the I. A. is strictly a vertical Union, and it may veer even more sharply in this direction before long. In fact, a vertical set-up offers I. A. the only possible means of furthering its interests in this field: its control must be complete, conclusive in studio, theatre and exchange if it is to be anything more than a stepchild in this business.

Lewis' record and present demeanor induce no particular thoughts of saintliness; and the gyrations of the craft unionists at the time the I. A. was raped by the I. B. E. W. (1933) certainly eliminates them as candidates for canonization. Although I. A.'s present interests palpably lie with the Lewis faction, it can afford to sit back composedly, secure in the knowledge that whichever way the tide of battle surges, the Federation as a whole has precious little to give or take away from the Alliance, which really is self-sufficient.

With 40,000,000 workers in this country, the Federation membership now totals less than 4,000,000—a certain indication of its static status. This after 50 years of domination by craft unionists.

Television Tests

Current television tests, about which the press is slightly hysterical, disclose nothing astonishing to informed technical workers. New York tests did just what intended by sending, by both cable and radio, 343-line images of 5 x 7 inches a distance of less than a mile. The definition, not bad now on the 343-line basis, will be even better when a 441-line image is adopted. The latter image will approximate in quality the halftones in this publication, provided the image size is not increased beyond 5 x 7 inches.

Double-Reel Situation

Introduction of the double reel nationally is only a little more than a month away—and many of its readers still await announcement of a reconciliation of views between the reel's sponsors and those Unions which to date have given no indication that they will accept the longer reel. At least three large-city Unions—Boston, Cleveland and Chicago—steadfastly refuse to handle double reels, and it is likely that there are more than a few other organizations with similar views.

The double-reel proposition was bungled from the start. The producers' first interest should have been the projection field, and they should have attempted to straighten out this tangle first. On the Union side, we can dis-

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TUBES THE FIRST SUSPECT WHEN AMPLIFIER FAILS

(*Continued from preceding page*)

back of the board, and we are out in front.

We decide that it would be easier to check the tubes, and finally do something. The tubes are taken out and are replaced by the tubes from the other '43 alongside of it. It's rather handy to have a flock of '43 amplifiers around at a time like this. Again this business of turning things over in my mind, which doesn't require any physical effort. The faulty amplifier is turned on. Lo and behold, 130 mils on the meter! That saved us a lot of trouble. It merely proved that suspicion should always be directed at the tubes first.

Tube Switch Proves Case

Not much else to do now, so the haywire tubes are put into the amplifier that had been O.K., turned on, and we get 20 mils. Just why we had to try that, I don't know, but it gave us some sort of satisfaction, or maybe there was a feeling lurking around in the back of our heads that something else could have been wrong. This last tack proves that it was only the tubes.

A spare tube is dug up, one that had been used. It is marked "high," meaning that it draws more plate current than the average tube. We place it in the amplifier and warm it up, test for plate current, and all we get is a bunch of sparks around the bottom of the tube. It is arcing across. We try it in the other '43. Why? Don't ask me. We only fix amplifiers, and can't answer such questions. Anyway, it arcs across in this amplifier also. So we are going to throw it away. No, why not worry ERPI with it? So it is placed to one side, and when ERPI arrives he will be asked to test it. Why? Don't know the answer to that one either; it must be the devil in some projectionists.

Two other tubes are tried. O.K., balance too. That's that. There we almost had a chance to do some neat brain work, but it turns out to be a couple of bum tubes. Say, I'm getting hungry. Let's go out and get a hamburger.

tribute no orchids, because in failing to formulate a *national* policy with respect to the long reel, the road was cleared for producers' representatives to walk in and make deals with Unions on a strictly local basis. The I. A. *Bulletin* did announce its unrelenting opposition to the longer reel, and asked that all Local Unions cooperate in opposing its introduction. Since that single blast—nothing.

Even now the producers persist in repeating their earlier mistakes. Avoiding the one and only place where they can obtain an authoritative answer as to the attitude of Unions nationally—I. A. headquarters—producer agents continue to visit local authorities and attempt to discredit the Union stand. A recent case in point is the visit to Boston by producer representatives, where they raised merry Hell in general and did everything possible to force the introduction of the longer reel—all on a *sub rosa* basis and without consulting the Union. The shortcoming of the producers here is not their zeal in behalf of a pet project but their stupidity in running around corners on a proposition that should be, but isn't, shot full of light down to the most remote corner.

Just a year ago, at a meeting of "master minds" in the Hays office in New York, the writer suggested that the first order of business in connection with the longer reel be to contact projectionist representatives and ascertain their attitude toward the project—not on any local basis but by a direct approach to national headquarters. This obvious move not having been made, any discomfiture experienced by the producers as a result of Union opposition is of their own making.

Legislative Data

A mid-West projectionist organization, preparing for public hearings on proposed state-wide legislation, appeals to I. P. thus: "Have you any data regarding occupational disease legislation in any of the various states? There is now being held a series of public hearings on legislation of this type in . . . . , and we should like to supply our representative with all necessary information . . ."

Fortunately, I. P. was not caught flat-footed, although the data it was able to supply was prepared in a great rush several years ago to make the deadline for another hearing, and it had only indirect bearing on the topic of the current hearings. Data on procedure in the other states was entirely lacking, as was to be expected in a work that had not been prepared specially for just such an emergency.

All of this leads directly back to a question projected many times by this writer: why isn't there some sort of bureau in national headquarters for the collection and dissemination of information on all matters of craft welfare which might conceivably have some bearing on helpful legislation? True, I. P. should and does participate extensively in such activities, but its facilitities do not permit the best possible job under any and all circumstances. Moreover, this is not rightfully an I. P. function, however willing it has been and will continue to be to assist in such work.

It would surprise the craft at large to know of the many and varied requests made of I. P. in this respect, by some of the largest I. A. units in the country. This is all pretty swell, and I. P. is glad to help, and even more joyful when its efforts result in success for a given Union. But, as often happens, I. P.'s facilities can be stretched to take in only so much area; frequently it is forced to admit its inability to be of service.

Surely this a slipshod method of handling a matter which is of vital concern to every individual member of the Alliance. We know of no first-flight Labor organization that does not have a bureau for the collection of such data. For some time there endured the idea that such work could be done by a group of I. A. men banded together in a technical society of one sort or another, and some progress was made in this direction. Eventually, however, hopes for the success of such a movement were dissipated for reasons too well known to need recounting here.

The only reason for the lack of such a bureau in national I. A. headquarters is that no representative group of Union leaders has ever pushed the issue. This implies no severe criticism of I. A. leadership during the past decade, because things of great import have been happening and have diverted attention elsewhere: the introduction of sound pictures, the collapse of the legitimate stage, the depression years, the struggle to regain lost ground, the NRA and one thing or another. Eventually the I. A. will establish such a bureau, like all other progressive groups, and there apparently is no better time to act than now, with general conditions pretty well in hand.

Projectionists are ever prone to water the leaves and neglect the roots, but this lackadaisical policy will net heavy dividends in lost opportunities to advance the welfare of the craft. This project is worth the best efforts of a representative group of projectionist leaders.

● ●

Hollywood Discovers Projection

Before color films reach perfection all theatre equipment—both projection machines and screens—will have to be standardized, so that each color film will have the reproduction qualities for which it was made.

ROBERT EDMOND JONES

Previously it was assumed that of the ranking production people in Hollywood only Cecil B. De Mille realized that there even was a projection process.

● ●

Better Optics, Not More Juice

The introduction of larger carbons drawing very much higher amperage is hailed in some quarters as proof of their contention that down this road lies the answer to more efficient projection, freely translated in their minds in terms of higher illumination. If this be true (and, of course, it isn't) let us go to 300 amperes, with suitable carbons therefor, and thus finally eke out of the set-up that amount of light which we need.

Overall Efficiency Only 24%

A. A. Cook, of Bausch & Lomb Optical Co., reports a total overall efficiency of 24% for the average projector optical system[1]. Now, does the introduction by National Carbon Co. of a new 13.6 mm. carbon drawing 180 amperes tend to increase the efficiency of the projector optical system and thus permit more efficient projection? Positively not. Proponents of larger carbons to be burned at higher amperages are merely citing the obvious but wholly wasteful method of raising screen illumination. They might well keep in mind the 76% light loss of *average projector optical systems* and throw their weight into the fight for long-overdue reforms in this direction.

Color Motion Pictures

"Dancing Pirate," thrust forward by proponents of color motion pictures as the finest flower of the art to date, appealed to us as a gorgeous flop. Why? For several reasons, including the following: (1) the print was dark throughout, and not as a result of insufficient projection illumination; (2) the color range was decidedly limited; (3) no given color stayed put upon the screen long enough to permit an opinion as to its tone; (4) what shadowing was apparent through a dismally dark picture overall was wrong, and (5) the color detracted from, rather than added to, the worth of the performance.

We were told that "Becky Sharp" suffered from a weak story and poor lighting; and "Dancing Pirate" was ballyhooed as the means for putting to rout the opponents of color. To us, "Becky" was a better job than "Pirate"; but both efforts merely served to convince us that if these pictures, and particularly "Pirate," are the best color jobs the industry has to offer, we might just as well forget about color for quite some time. Color in itself is no potent box-office factor, the records will show, thus removing the only reason why production costs should be doubled or tripled.

[1] I. P. for May, 1936, p. 18.

Question and Answer

Q. I have before me literature on two analyzers —— and —— and am somewhat puzzled which to select. Can you give me some information based on practical experience?

F. G., Calif.

A. Only that both instruments are thoroughly reliable. Make sure that the one you pick is capable of testing the largest tubes and highest-voltage circuits in your installation. You do not mention what sound equipment you have.

New W. E. 300A Power Tube for Theatre Sets Compared With the 242A

By J. O. McNALLY

MEMBER OF THE TECHNICAL STAFF, BELL TELEPHONE LABORATORIES

Data given in the appended article requires supplementary explanatory comment. It will be noted that Table 1 gives the output of two 300A's in push-pull, with 325 volts plate current, as 15 watts. The last paragraph of the article cites the output of two 300A's in push-pull, with 450 volts on the plate and a plate current of 60 milliamperes, as 25 watts. This distinction is important in figuring operating efficiency.

Any comparison relative to efficiency and cost between this 300A tube and RCA's 6L6, described herein last month, should allow for different bases of engineering calculation with respect to harmonic content, tube life and overall type of amplifier used.—*Editor.*

THROUGH the development of a new power vacuum tube—the 300A—improved amplifiers for sound picture and public address systems are now available at lower cost. One of the factors contributing to this cost reduction is a decrease in the operating plate voltage, which has made possible savings in the rectifier equipment contained in the amplifiers. This lower plate voltage has also made possible economies in the construction of the tube. This results in lower maintenance cost due to the lower cost of tube replacements.

Improvements in the electrical behavior of the 300A tube are indicated by comparing its operating characteristics with those of the 242A tube, employed in the 43A amplifier, used at present in the majority of theatres equipped with W. E. sound systems. The new 300A tube is employed in the 86A amplifier, which is designed for similar purposes.

The comparison is given in Table 1. The 242A tube requires a plate voltage of 800 volts, or more than twice that of the 300A tube. The power output of the 43A amplifier is 12 watts; whereas 15 watts is obtained from the 86A amplifier. The filament power required for the 242A tube is five times that for the 300A tube. Comparative sizes of these two tubes is illustrated in Fig. 1.

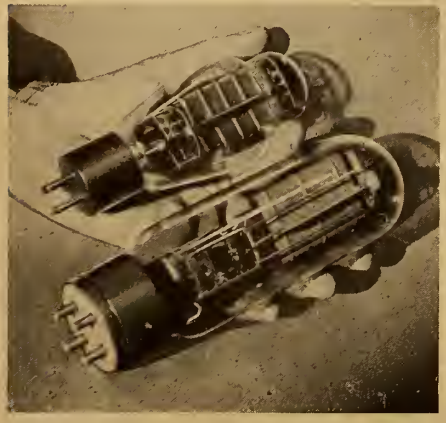


FIGURE 1

Comparative sizes of 300A and 242A W. E. tubes

Tube Operating Characteristics

Like the previous tubes, the 300A is a triode. It has an oxide-coated filament which may be operated on 5 volts a. c., normal filament current being 1.2 amperes. The plate is formed from sheet nickel, blackened by a carbonizing process to increase its heat-radiating ability. Molybdenum wire, wound flat and welded to two nickel support wires, forms the grid.

TABLE I

Type Tube	242*A*	300*A*
Operating plate voltage	800	325
Operating plate current —milliamperes per tube	67.5	60
Power output in watts of two tubes in push-pull	12	15
Filament power in watts —per tube	32.5	6

The general appearance and construction of the tube are shown in Fig. 2, where the base with filament and grid structure are in the left hand, and the plate structure in the right. With a plate potential of 350 volts and a plate current of 60 milliamperes, the normal grid bias is—74 volts. A single frequency input of 74 peak volts will deliver 8.5 watts to a 3000-ohm resistance load in the plate circuit.



FIGURE 2

Disassembled elements of 300A tube

The ability to obtain large power outputs from the 300A tube with low plate voltages is made possible by the low plate resistance. This reduction in plate resistance has been accomplished by decreasing the amplification factor, by decreasing the spacing between the elements—particularly that between filament and grid—and by increasing the area of the elements. The amplification factor has been reduced to the lowest practical limit, which is set by the point at which the varying current in the plate

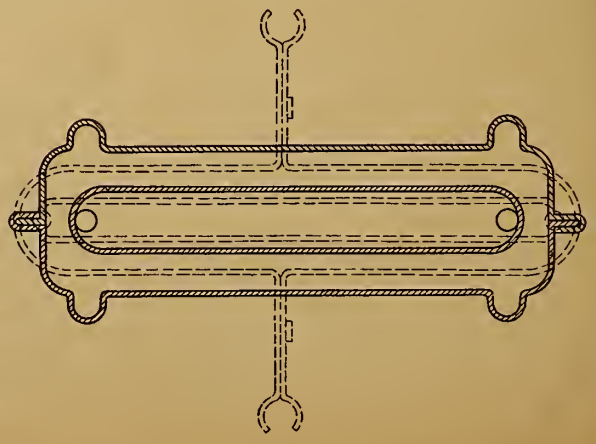


FIGURE 3

Cross-section of 300A tube, shown in dashed lines, superimposed on a similar cross-section of the 252A tube in solid lines, indicates one method employed to decrease plate resistance



FIGURE 4

Testing tubes for shock

circuit ceases to be sufficiently linear with the input voltage, and causes distortion in the output.

How the inter-electrode spacing has been decreased and the areas increased is indicated by Fig. 3, which shows a cross-section plan of the 300A tube in dotted lines, superimposed on that of the 252A tube which is an earlier tube of approximately the same bulb size and developed for plate potentials up to 500 volts. This latter tube is capable of delivering only about one-half of the power of the 300A tube under similar operating conditions.

Important Structural Changes

The plate of the 300A tube has been widened in the direction of the plane of the filament and the transverse spacing made less. To obtain the increased width of the plate without using a larger bulb, the plate construction has been changed. In the 252A tube the two halves of the plate are joined by flanges at the ends, and four support wires are fastened to the plate near the corners. In the 300A tube, the two halves are joined by wide flanges on the sides, to which the support wires are secured. This allows the plate to occupy the entire distance in width occupied by the plate and flanges in the 252A tube, and has the additional advantage of stiffening the middle portion of the plate.

The grid has been correspondingly widened in one direction and narrowed in the other to decrease the distance between the grid and filament.

Besides these changes, it has been essential to have the filament extend the full length and width of the plate, so that the plate current may be drawn as nearly as practicable over the entire plate area. This has been accomplished in the 300A tube by arranging the filament in a double M instead of the single M usually used. This is shown in Fig. 2. The two M's are connected in parallel across the filament voltage supply.

In bringing the filament, grid and plate closer together, the danger of short-circuit from accidental physical contacts of the parts has been increased. Design features—such as the side ribs on the plates, and the rigid fastening of both ends of the support wires—improve the stiffness and offset this danger.

The inherent stiffness of the tube elements is tested by attaching the tube to a cord and allowing it to swing as a pendulum against a stop in the center position. Such a test is shown in progress in Fig. 4. The tube is drawn back to increasing angles and then released, and the angle at which failure occurs, as indicated by a relay circuit sensitive to short-circuits of very short duration, is a measure of the stiffness of the elements.

Maximum Plate Voltage

Typical characteristics are shown in Fig. 5. The output of the tube will depend, of course, on the plate and grid voltages selected. As the result of extensive life tests, it has recently been possible to raise the maximum operating plate voltage for the 300A tube from 350 to 450 volts. With 450 volts on the plate and a plate current of 60 milliamperes, a single tube will deliver 12.5 watts into a 400-ohm load with second and third harmonics 26 db and 39 db, respectively, below the fundamental.

Two such tubes in push-pull may be expected to deliver 25 watts with harmonic levels of the order of 40 db below the fundamental.

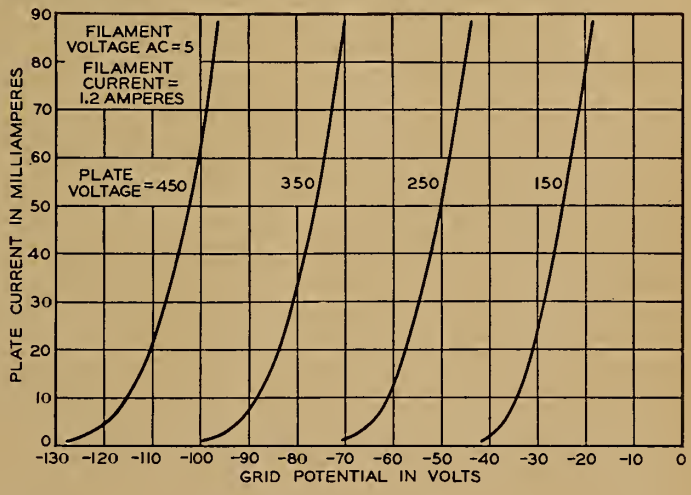


FIGURE 5

Plate current and grid voltage characteristics

Sarnoff, RCA Head, Discusses Television Possibilities

FORMAL opening of the New York City television field test station atop the Empire State building produced an authoritative statement on the commercial possibilities of this baby art by one best qualified to give it, David Sarnoff, president of RCA, sponsor of the test. Said Sarnoff, in part:

"As a commercial operation, television has not yet arrived, it is not around the corner, nor even around the block. But we have advanced sufficiently far to say that the technical obstacles are not insuperable. RCA has invested millions of dollars and an incalculable sum of scientific genius in bringing television to the point where it may be moved from the seclusion of the laboratory to the freedom of an experimental service in the field.

Larger Image Vitally Necessary

"The test period may be a long and costly one. Critical technical problems must still be solved. The present range of television transmission from a single station is scarcely more than 25 miles, and existing wire facilities are not suitable, for inter-connecting television stations. Radio relays or a modified wire system must be developed to enlarge the range and potential audience for a single costly program.

"There is also the problem of further increasing the size of the television picture without loss of clarity. The experimental television observer today watches the stage from the backrow of the second balcony. We want to give him a seat in the front row of the orchestra. When television broadcasting reaches the stage of commercial service, advertising will have a new medium, perhaps the most effective ever put at its command.

Will Not Supplant Broadcasting

"The new medium will not supplant or detract from the importance of present-day broadcasting. Rather, it will supplement this older medium of sound. Television will add little to the enjoyment of the symphony concert as it now comes by radio to your living room. Sound broadcasting will remain the basic service for the programs particularly adapted to its purpose. On the other hand, television will bring into the home much visual material—news events, drama, paintings, personalities—which sound can bring only partially or not at all.

Service Free; Advertising Will Pay

"The benefits which have resulted from the industrial sponsorship of sound broadcasting indicate that our major television programs will come from the same source. It requires little imagination to see the advertising opportunities of television . . . Commercial announcement can be expanded through television to include demonstration and informational services that will be of value to the public as well as to the advertiser.

"Broadcasting has won its high place in the United States because—unlike European listeners—American set owners have had their broadcasting services free. Despite the greater cost of television programs, I believe that owners of television receivers in the United States will not be required to pay a fee for television programs. That is an aspect of the television problem in which the advertising fraternity will doubtless co-operate in finding the solution."

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

BETWEEN eighty and eighty-five million persons attend weekly the 15,378 motion picture theatres operating in the U. S. (calculated on a total admissions basis), according to the *Motion Picture Almanac* for 1936-37, just published. Other interesting facts contained in this volume: About 80% of these patrons buy their tickets between 7:30 and 8:30 p. m., and they spend between 720 millions and one billion dollars annually therefor.

Out of this, ultimately, comes the weekly Hollywood payroll of $1,500,000, received by 28,000 persons employed in production, by 8,000 in the distribution end and by 236,500 in the exhibition field. The new edition of the *Almanac* contains 1,384 pages, 742 of which are devoted to biographical sketches of 13,112 persons in and closely related to the industry. The corporate structure of and statistical data pertaining to 66 film companies is also included.

Ousted Cincinnati Men Sue Union, ex-I. A. Head

Damage suits totalling $54,000 have been filed in the Common Pleas Court of Cincinnati by former officials and members of the old Local Union 165 against William C. Elliott, former I. A. president, 18 members of the succeeding organization, now Local 327, and their counsel.

The petition recites that charges growing out of personal animosity precipitated by internal political strife, were brought against the plaintiffs, which resulted in revocation of the charter without reason, impeachment of the officers and the subsequent formation of the present Local 327 from which the plaintiffs were excluded. They have since been unable to obtain union affiliation or recognition, and have for four years been deprived of their earnings as operators, it is claimed.

The plaintiffs and the damages asked are: Harry Schwartz, former president, $14,000; William Hahn, former business agent, $16,000; John King, $12,000 and James Curtis, $12,000. The salaries at the time were fixed at $3,500, $4,000 and $3,000 respectively.

New Tube Visualizes Electron Phenomena

To augment theoretical discussion with a practical demonstration, a new type WL-787 triode tube for visualizing the electronic effect when changes are made in the grid and plate voltages of a vacuum tube, is announced by Westinghouse Lamp Co. The filament consists of several parallel oxide-coated wires, all of which are located in one plane so that the plate current will be uniformly distributed. The anode is the fundamental flat plate mounted parallel with the plane of the filament. The grid comprises a fairly open and conventional structure mounted between the filament and plate.

The side of the anode facing the grid and filament is coated with Willemite, which shows a bright greenish fluorescence when bombarded with electrons of the plate current. A pronounced and clearly visible glow shows up at all points where the electrons strike, resulting in a definite pattern of the grid on the plate. Plate size is such that the action can be observed by everyone in a room of reasonable size. Either a. c. or d. c. power may be used to heat the filament and to supply voltages for the grid and plate.

New Associate Members in Independent Dealer Group

Associate memberships in the Independent Theatre Supply Dealers Assoc. have been granted to Wil-Kin Theatre Supply Co., Atlanta; Falls City Dealer Equipment Co., Louisville, and the New England Theatre Equipment Co., of Springfield, Mass. Associate membership is a prelude to full participating membership within a short time.

Brazil 3-Dimension Process

Three-dimensional motion pictures have been "perfected" by Dr. Sebastiao Comparato, of Sao Paulo, Brazil, according to his own announcement. From the meager details supplied, it appears that the third-dimension effect is accomplished through the use of a special screen, about the size of a standard screen, which is built of copper sheeting mounted on a structural steel frame. This copper surface is first coated with a layer of gelatin, then another layer of absorbent fibrous material is applied which is treated with silver salts. The screen is mounted at the rear of a dome-shaped structure made of the same materials.

Dr. Comparato explained that the variance in depth of absorption of light rays by the screen gave the effect of depth in the projected image. Apparently no modification is required in either the film or projector, although the sound apparatus had to be changed in minor respects in order to conform with the odd construction of the screen.

South Africa Latest To O. K. S.M.P.E. 16 mm. Standards

The 16-mm. sound-film standard of the Society of Motion Picture Engineers has been adopted for South Africa by the S. A. Standards Assoc. The American standard was preferred to the German, the report points out, because the British Standards Institution will follow the American and requested its South African affiliate to adopt the same standard.

Neumade Prod. Rewinder For Standard 2000-Foot Reels

A new rewinder for the standard 2000-foot reels, due Sept. 1, has been announced by Neumade Products Corp. of New York. Known as the Neumade Dynamic Rewinder, this unit is made either with a 2½-to-1 or a 4-to-1 ratio, having either a two- or three-point base. It is equipped with four finest quality precision ball racers and steel-cut gears.

The rewind made up for three types of action, namely, the standard-geared end, extension arm brake, or a handle brake. The spindle or reel shaft is equipped with a large reel bumper collar, perfectly balanced throughout. The bearings are the sealed type, packed with grease, and are self-lubricating, the only rewinder made that need not be oiled. These rewinders carry a three year guarantee, and have already been adopted by major producing companies.

Color and Recording Advances Cited in SMPE Report

(*Continued from page* 14)

the replacement of the four-lens turret by a single lens with bayonet lock. Outside the camera proper the finder has been arranged to focus and parallax automatically in conjunction with changing the lens focus in follow or follow-focus shots. All this mechanism, together with the magazine and motor, and with the exception of the finder and follow-focus mechanism, is in an insulated housing, the function of which is to absorb the sound.

The operating controls are all on the outside, so that it is necessary to open the outer housing only to thread the camera. All other operations, such as focusing, changing the magnification on the focus tube, changing the filters in the focus tube, the hand dissolve and the automatic dissolve, are all accomplished from the outside. The weight of the whole equipment with 1000 feet of film is 135 pounds, which is considerably lighter than the lightest blimp in use. The camera is adapted to use either the W. E. interlock motors or the regular synchronous motors.

Lenses and Shutters.—No exceptional advancements have been made in camera lenses during 1935. A faster series of Speed Panchro lenses (*f*/1.3, 2¼-inch focus) has been put upon the market. Altman has described a revolving panoramic lens that has unusual

possibilities as a wide-angle lens. A more detailed description of the German mirror telephoto lenses has been published, and there are the usual patents on new or improved forms of lenses.

The Eastman Pola-Screen

A very interesting accessory to the optical field is the Pola-Screen introduced by the Eastman Kodak Co. This screen gives the operator a hitherto impossible control of the polarized light entering the lens of the camera, making available several of its peculiar characteristics. The elimination of reflections is now simple, maximum results being attained when the optical axis of the lens is at a 32-degree angle from the reflecting surface, as at that angle the light reflected from most surfaces is fully polarized. Sky-filtering is possible when the lens axis is at right angles to the sun's rays, which will prove of value in color photography, since the Pola-Screen is of neutral color value.

The Pola-Screen opens up possibilities also in the field of stereoscopy, applying it in a manner somewhat similar to viewing a blue and red positive through corresponding blue and red glasses, but without the color interference.

Stage Illumination.—The rapid progress made in new types of gaseous conductor lamps during the past year or so continues to be of outstanding interest in the lighting industry as a whole. The laboratories of the Philips Lamp Co. of Holland, as well as those of the General Electric Co. in the United States, have produced mercury-vapor lamps of the air-cooled type having brightnesses of the order of 20,000 candles per square-inch; and of the water-cooled type, about 150,000 candles per square-inch. By way of comparison, the old familiar Cooper-Hewitt mercury-vapor tube had a brightness of 15 candles per square-inch, and the high-efficiency incandescent lamp can be operated at brightnesses up to 20,000 candles per square-inch. These lamps, in general, consist of a quartz tube with electrodes at each end, and are enclosed within a protective housing. The experimental air-cooled lamps had light-sources approximately 4 millimeters in diameter and about 10 millimeters in length. The water-cooled types were slightly smaller. Since they possess the characteristics of an arc, *they must be used in conjunction with either a resistor or reactance ballast.* (Italics ours.—Ed., I. P.)

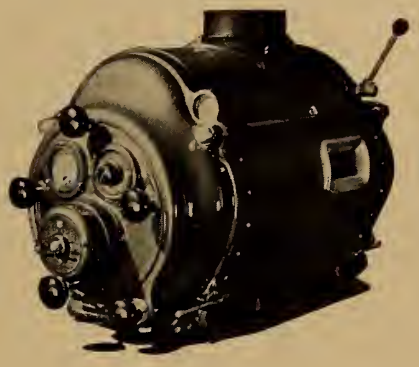
Operating the mercury-vapor source at these high brightnesses results in considerable improvement in the quality of the light, but nevertheless the light retains much of its usual blue-green properties. At the present time their application as light-sources for studio motion picture photography appears rather remote, particularly when the severe requirements of color photography are considered. The extremely great brightness of the water-cooled lamp offers possibilities as a projection source.

Since photography is so dependent upon the source of light, mention should be made of the new Mole-Richardson spotlights for both incandescent and arc lighting. Their 2000-watt Junior and 5000-watt Senior Solar Spots, with Fresnel lenses, provide a uniform field of illumination with no "ghost." This like-

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wise applies to their so-called *HI* type of high-intensity arc spot, which is especially valuable in color photography and is finding a place in black-and-white photography also because of the reasons mentioned above. Their 120-ampere spot has an intensity equivalent to that of the 24-inch Sun arc; and their 150-ampere spot is claimed to equal the 36-inch Sun arc in intensity. In both lamps the beam may be varied from parallel to a 44-degree angle.

Color Movies Forge Ahead

Color.—The revived interest in color processes noted in 1934 continued throughout 1935, stimulated no doubt by the introduction of the Kodachrome process previously mentioned. The first three-color, feature-length motion picture was released in June, 1935. It was entitled *Becky Sharp*, and was made by the Technicolor imbibition process. The picture was made entirely by artificial light; but a second feature, *Trail of the Lonesome Pine*, released in the Spring of 1936, was made almost exclusively outdoors.

Technicolor made great advances with their three-color process, with pictures now showing or in production that will no doubt revive color interest in the industry. Good definition, depth of focus, and a conservation of color values make the process the only practical one to date in the 35-mm. field.

Color.—The outstanding event in the amateur motion picture world during 1935 was represented by the introduction of the Kodachrome Process by Eastman Kodak Co. This is a process of amateur cinematography in colors. It is a three-color subtractive process, the dyed images being incorporated in coatings upon one side of the film. It has an advantage over earlier amateur motion picture color processes in that the image is not broken into small units by screen elements or lenticular embossings.

In the Kodachrome Process the film is coated upon one side with five layers. Next to the support is a red-sensitive emulsion; upon this, a layer of gelatin; then, a green-sensitive emulsion; then, another layer of gelatin; and upon the top, a coating of blue-sensitive emulsion. The upper layer carries a yellow screening dye to prevent the blue light from reaching to the two lower emulsions. The film is exposed in any 16-mm. camera at approximately one stop larger than used for black-and-white pictures, without filters or other attachments, and can be run interchangeably with black-and-white film without any appreciable loss in screen brightness.

In processing, the images are developed by a reversal process which converts them into positive dye images that are complementary in color to the spectral regions to which the layers respond. Processing can be done only in the Eastman Kodak stations. The film is supplied in 50- and 100-ft. spools, and in magazines, and in 16-mm. width only.

Sound Recording Advances

The past year has been marked by a renewed interest in improving both sound recording and reproduction. The invalidation of the Tri-Ergon patents by the U. S. Supreme Court opened the way for intensive development of sound equipment which had been barred previously by the claims of these patents.

A demonstration of push-pull, variable-density recording was given by Douglas Shearer, of the M-G-M Studios. The sound was projected with the Fletcher two-way horn system previously mentioned. M-G-M used the push-pull method for all original recording at the studio during the past year, re-recording to standard width track for the release prints.

Recording Equipment—RCA made several improvements in their studio recording equipment during 1935. A light-modulating system was produced and installed in several studios which utilized a beam of light only 1/6 of a mil. thick for exposing the film. An improvement in the efficiency of the optical system and a new recording lamp made it possible to realize the increase in high-frequency response and the reduction in distortion.

The recorders are equipped with apertures for either push-pull or single-track recording.

Reproducing Equipment.—Continued progress was noted in improvements in sound reproducing systems, attention being given to the film motion and to extending the frequency range of reproduction by the introduction of novel horn designs.

Erpi has announced a new high-quality reproducer set which forms part of a low-priced system recently announced, and has been designed with particular attention to the requirements of the small theatre, high quality, economy, and simplicity being emphasized. The type 209 reproducer set, as it is designated, may be attached to the picture projector with unusual ease, as all gears or other forms of drive have been eliminated between the picture mechanism and the sound reproducer. This avoids difficult alignment problems and "shimming." Sprockets are not required in the reproducer set, as the film is propelled only by the sprockets of the projector mechanism.

The new "Kinetic Scanner" controls the film motion and prevents flutter. The scanning system includes a prefocused-base exciter lamp, a high-efficiency optical system, and a p.e. cell of greatly increased sensitivity. A special transformer is included for connecting the reproducer set to the system main am-

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plifier; no amplifier is required at the machine.

The same company has also introduced horns of the "multi-cellular" type (Fletcher horn.) The horns are divided into diverging rectangular sections which distribute the sound uniformly over prescribed vertical and horizontal angles, assuring faithful balance at all frequencies. A new receiver having an efficiency about 100 per cent higher than any unit heretofore produced has also been developed. One to four receivers may be attached to a horn. Special throats are employed for connecting the receivers to the horn; the spaces surrounding the diaphragms of the receivers are specially designed to couple the diaphragms with the air columns of the horn efficiently and without distortion. The total depth of the horn is about 40 inches, thus allowing practical and convenient backstage arrangement.

RCA announced new high-fidelity, a. c. operated reproducers employing the rotary stabilizer form of control, and having increased power output and optional speaker complements to suit the requirements of individual theatres.

Progress in Projection Field

Projectors and Accessories.—The past year has seen a definite trend toward high-intensity projection by theatres of small and intermediate size, replacing the low-intensity reflector arc which has been in almost universal use in theatres of these classes. This change in projection practice has been made possible by the development of the Suprex projector carbons, together with improved lamps for their operation. Now that these new carbons and lamps have placed high-intensity projection within economic reach, the smaller theatres are rapidly availing themselves of the advantages already demonstrated in that respect by the large down-town theatres, in which high-intensity projection lamps have been in use for a number of years.

The theatre-going public has definitely shown its preference for the improved quality of projection light, the superior projection of color features, and the higher level of general illumination that high-intensity projection makes possible.

For some time there has been a demand by a number of the larger theatres for still more intense illumination than could be supplied by the 13.6-mm., high-intensity projection carbon operated at 120-130 amperes. This demand has now been met by the development of a 13.6-mm., super-high-intensity carbon adapted to steady operation over a current range of 140-190 amperes. At the upper limit of current this new super-high-intensity carbon provides 30 per cent more light than the regular 13.6-mm., high-intensity carbon. There is also a more uniform distribution of brilliancy across the face of the crater of the new carbon, resulting in less contrast in screen illumination between the center and the sides or corners of the screen.

The lamp companies have recently made available an 8-volt, 2-ampere *T*-8 bulb sound-picture reproducer lamp of improved characteristics. This lamp, in

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general, replaces the widely used 8½-volt, 4-ampere lamp of similar dimensions. Its low current rating permits operating it on rectifier filter systems of relatively small size and weight. The proportions of the source are such that the lamp operates particularly well with reproducer optical systems incorporating cylindrical lenses as well as with those of the aperture type.

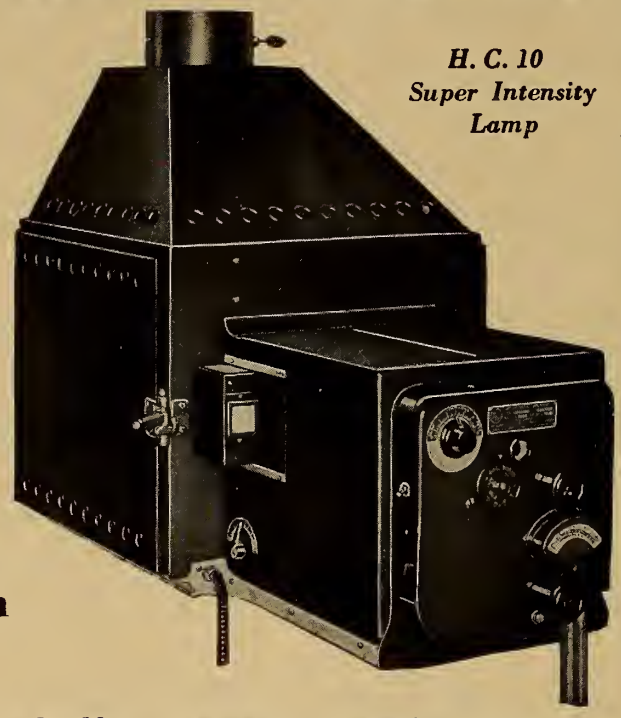
The lamp is available with the standard single-contact bayonet base as well as with the new precision prefocus base. The prefocus base makes it possible to position the lamp correctly in the optical system by merely inserting it into its special socket. This is a particularly valuable feature for portable and semi-portable equipment when the usual skilled operators are not available. The lamp is applicable also to a number of 16-mm. sound-picture projectors.

In connection with their studies of various types of recording and reproducing lamps for sound-picture work, the General Electric Co. have developed a special form of microphotometer which makes possible the measurement of brightness distribution across the scanning-beam as well as the total scanning-beam brightness for various types of optical systems and lamps. This company has recently placed upon the market a compact, inexpensive foot-candle meter, which should prove valuable to theatre servicing organizations for checking screen and auditorium illumination, etc.

Zeiss has brought out a new series of projection objectives for theatres, the focal lengths of which range from 120 to 180 centimeters. The mounts are either 80 or 100 millimeters in diameter.

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Notes on The S.M.P.E. Progress Report

The foregoing report invites comment in several particulars. Noteworthy is the fact that practically all of the advances cited, particularly those affecting projection, were described in detail in these pages almost as soon as they became known.

The Pola-Screen is the subject of a detailed statement elsewhere in this issue. Gaseous conductor lamps, commonly known as mercury-vapor lamps, have been discussed herein, with competent opinion holding that this development still is far removed from application to practical projection work. The Kodachrome color process of Eastman (which firm has a working arrangement with Technicolor) augurs well for the early arrival of a satisfactory three-color process.

Sound recording and reproduction benefited enormously through the introduction of push-pull recording (and now reproduction) by RCA, and the pending plans for widespread use of multi-cellular speakers. The necessary modifications of RCA soundheads for the reproduction of push-pull recordings are detailed in an article elsewhere herein.

The Erpi 'Kinetic Scanner' Again

Special comment is due the mention of the Erpi Type 209 reproducing equipment designed for small theatres. This unit employs the "Kinetic Scanner," the development of which I. P. considered as an effort to approximate the RCA Rotary Stabilizer (I. P. for April, 1936, p. 24). This "Scanner" is surrounded with considerable secrecy, it appears, since I. P. has been unable to learn of any theatre which kept this unit in for long. A paper on this unit scheduled for presentation at the Spring, 1936, meeting of the S.M.P.E. was cancelled a week prior to the meeting. It is reported that no little difficulty has been experienced by Erpi in obtaining approval of this unit by fire authorities in the field.—*Editor.*

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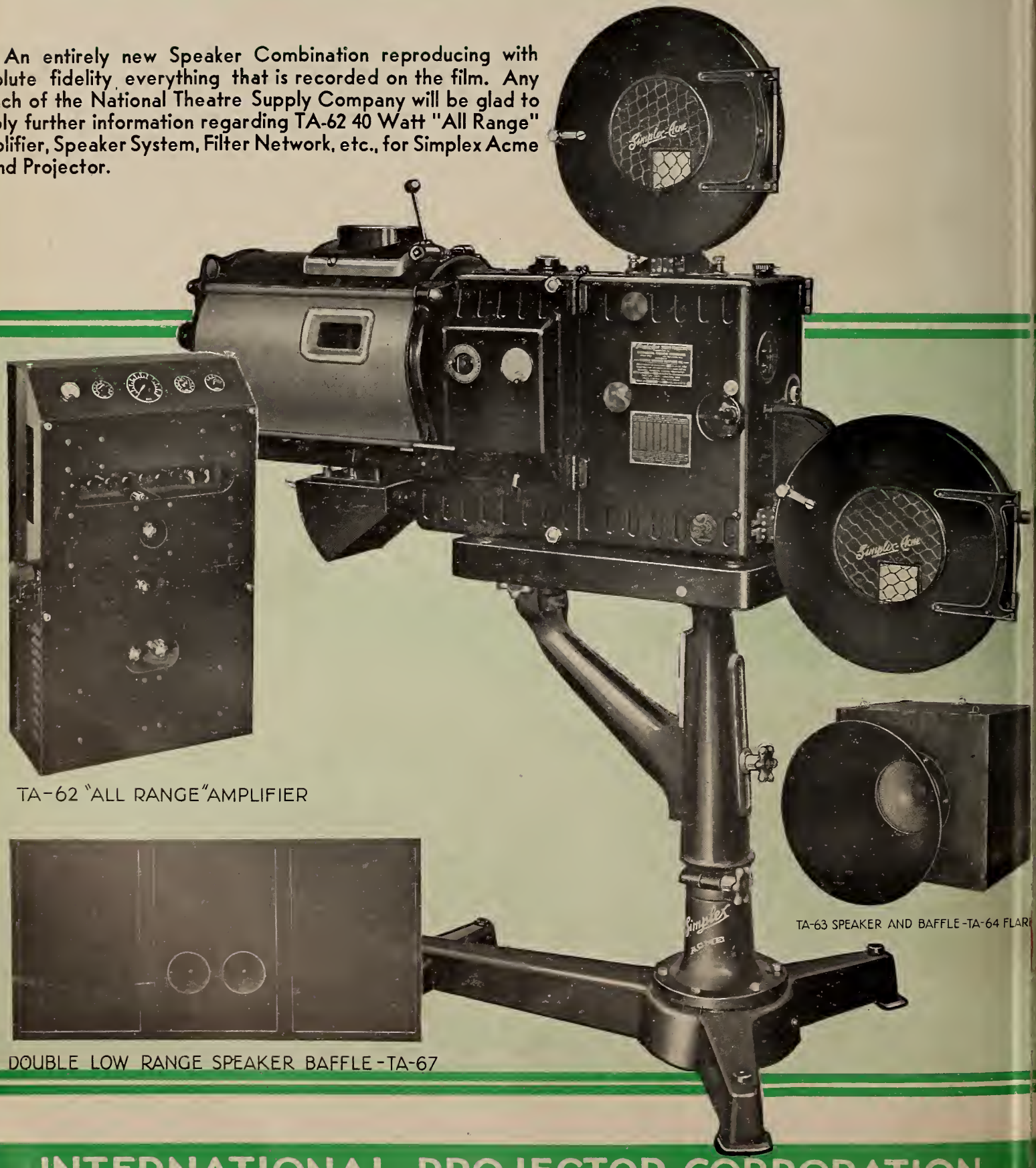
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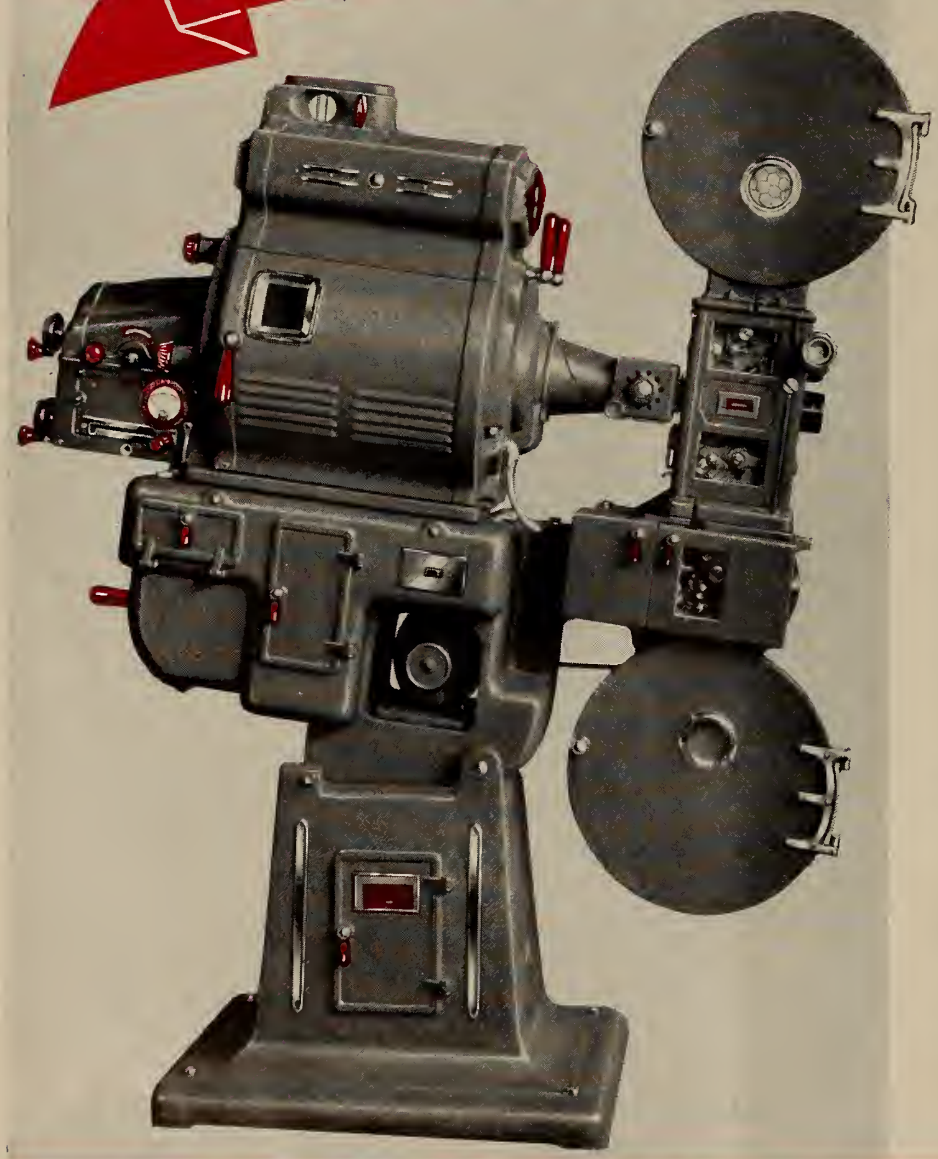
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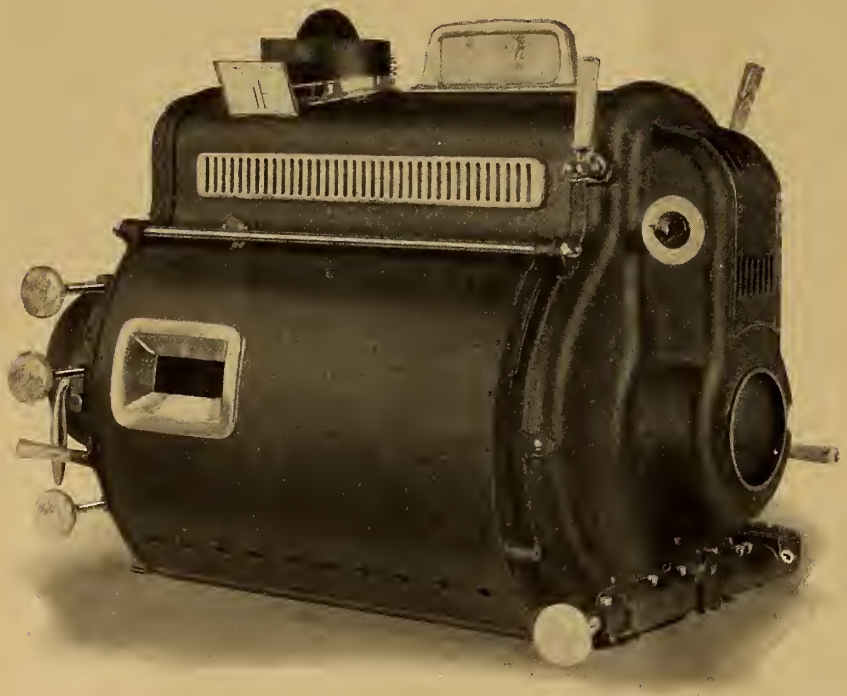
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Volume 11 AUGUST 1936 *Number 2*

Index and Monthly Chat 5

Maintenance Problems of the High-Intensity Arc 7
A. C. SCHROEDER

Color in Motion Pictures Held Distracting 8

What About 16 mm. Projection? 11
JAMES J. FINN

Step-By-Step Analysis of Sound Reproducing Equipment XX 12
AARON NADELL

Letters to the Editor 17

'Regular' Simplex Off Market; Replaced by 'Super' Head .. 18

Uniform National Projection Laws Proposed by Leading Craftsmen 19

The W. E. 86-Type Amplifier.. 20
V. M. COUSINS

Mass. Bans Doubles; Anomolous Union Situation; Projection Problems 22

The Editorial Page 23

The Keller-Dorian, Three-Color Motion Picture Process 24
WILLIAM E. CELESTIN

RCA to Service 300 Erpi-Equipped Theatres; Erpi's Competitive Service, New Reproducer 25

News of the Month 26

News Notes

Technical Hints

Miscellaneous Items

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MONTHLY CHAT

GREAT gobs of information for the alert projectionist in this issue: A new Erpi amplifier using the new 300A power tube described herein last month; the first circuit analysis of the Simplex-Acme sound system; data on the projection requisites of the Keller-Dorian 3-color process; a timely warning on 16 mm. film equipment operation; more about Suprex arc magnification ratio—these and many other topics are covered.

It's funny: a new Erpi tube in the last issue, and now a new amplifier using that tube. Not deliberate, so help us, but it proves again that consistency is a jewel. The feller without last month's I. P. will be at a disadvantage in absorbing the amplifier dope this month.

SEPT. 1 is here and still unsolved is the great mystery of the new standard double reel. More about this engrossing subject herein.

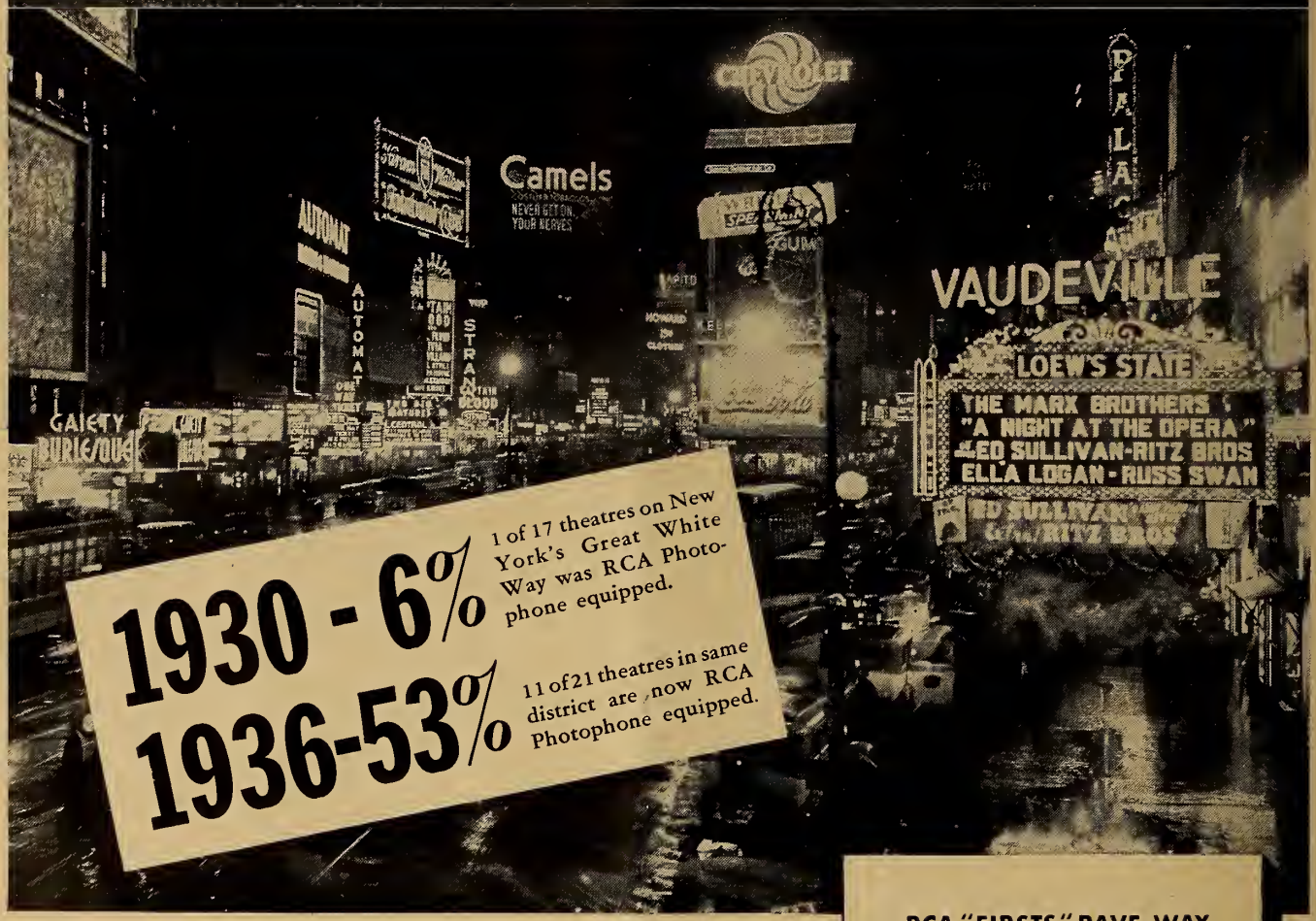
THEATRE sound system servicing takes still another twist, with the electrics closing deals with major circuits for 100, 200, and 300 theatres at a clip on a single contract. We have a vague recollection of having dealt with this topic sometime during 1935, but we can't be sure until we consult our files. Oh, yes, we remember now. The story went something like this—"Once there was a projectionist organization . . ."

COMING soon—a detailed description of the entire RCA High Fidelity reproducing equipment demonstrated at the I. A. Convention in Kansas City and which sent the boys out of the demonstration hall talking to themselves. From speakers to projector optical system complete, with no detours. For good measure there will be thrown in explicit data on RCA's Ultra-Violet Recording.

WHAT, asks a perplexed projectionist, would we suggest that he say before a local Chamber of Commerce which invited him to "explain" the projection process "in fifteen minutes." Well, we answered, tell them all about decibels, and dynes, and micro-amperes, and secondary emission, and lens speed, and photocells and a few dozen other things about which they now know nothing and will know less after the talk. These Commerce boys are out for a meal, not for education, and they want fancy, not fact, with their soup and crullers. That which they don't understand they appreciate all the more.

A NEW show season is almost here. Have you braced the boss for a new screen, a projector overhaul, new reflectors, improved room ventilation, a new lamp, ample spare tubes, photocells and exciter lamps or any of those things that make for a better job all around. If you've already tried and failed, give it another whack. The boss might begin to think you mean it.

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INTERNATIONAL PROJECTIONIST

VOLUME XI NUMBER 2

AUGUST 1936

MAINTENANCE PROBLEMS OF THE HIGH-INTENSITY ARC

By *A. C. SCHROEDER*

MEMBER, PROJECTIONIST LOCAL UNION 150, LOS ANGELES, CALIF.

DISCUSSION of high-intensity arc maintenance among projectionists evokes many and varied opinions, some of which are astounding to one having long experience with this mechanism. This arc lamp is a piece of machinery that requires the application of common sense principles, the same as any other unit of machinery: proper lubrication, the proper parts in correct alignment, and overall care so that the lamp may not fall apart.

Some of these requirements are easily met, primarily because this piece of machinery moves at slow speed, which circumstance is balanced by the factor of intense heat. The arc must conduct a large current at high temperature. The main task is to keep the crater in the positive carbon at an even temperature, while the carbon revolves and moves forward at a regular rate to insure a clear, even illumination of the screen.

Drive, Gearing Fitted Closer

Experience teaches us that the moving parts must be fitted rather freely—"sloppy," if you will—because of the heat. Different parts will not expand to the same degree, of course, and some leeway is necessary to prevent binding.

Parts in the motor drive and associated gearing are fitted closer, being comparatively cool and revolving at greater speed; also, they are protected from dirt and carbon particles, thus are more easily lubricated, making it safer to fit the shafts and bearings in a more conventional manner.

Although the operating speed of the parts in the element proper is very slow, and there is apparently very little vibration, the various set screws, *etc.*, have an uncanny habit of working loose, requiring almost constant tightening. Power transmission is not great, yet pins sometimes shear off; and pins used as keys, working in slots in hollow shafts, wear badly and require occasional replacement. These things, while not serious, are annoying and require continual watchfulness—or else!

High-intensity lamp lubrication is a serious problem. Some projectionists use ordinary oil, although this practice is not widely prevalent. Heat carbonizes the oil, which subsequently takes up what play there is in the moving parts. Result: the lamp binds. This accumulation must be removed, usually with sandpaper or emery cloth, both of which leave grit and abrasive particles which cut and score moving parts. Emery cloth wears the parts unnecessarily.

A mixture containing flake graphite is widely used, lubricating quite well, but this also cakes after continued use and must be removed. Liberal use of this mixture may get across insulation and form a partial "short" or ground. I have seen this happen, with brilliant sparking, although no great amount of current was involved. Unfortunately, no measurements were made.

My personal preference for H-I lubrication is vaseline, which I have used with great satisfaction for eighteen months, running nine hours daily. I stand alone here, however, for my colleagues present many strong arguments against it. In rebuttal, I can only point to my personal experience. Only a small dab of vaseline is needed at each point, applied whether the lamp be hot or cold. In either case the vaseline becomes fluid and runs into the bearings.

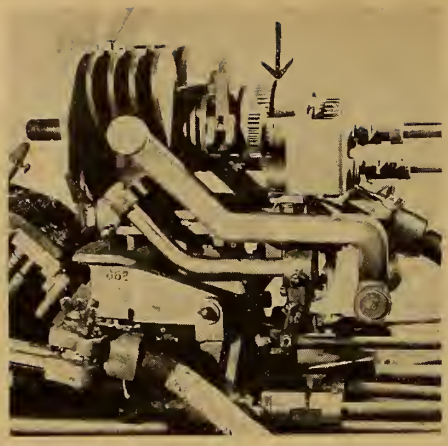


FIGURE 1

Vaseline does not cake or carbonize. Used only once a week, vaseline insures smooth operation.

At present we are using a colloidal graphite, the latter seemingly suspended in some sort of water mixture. This is sprayed on the parts while they are hot: the liquid evaporates and leaves the graphite on the surface. Thus far it has not caked or carbonized; but we find that the lamps must be lubricated every other day.

Some Parts Overlooked

There are some lamp parts that projectionists continually overlook, such as the thrust washer positioned behind the scroll on one type of lamp. Known as the "scroll spacer," it is hard to see, its diameter being less than that of the scroll or the casting behind it. Applying the lubricant so that it runs down from the top of the scroll, on the side toward the rear of the lamp (Fig. 1), this spot is properly attended to. On the same lamp is a cross shaft from the reduction gear case, just below the motor, to the large gear box on the right. That part of the casting surrounding the shaft is set back in a crevice, on top of which round part is an oil hole, not easy to see. Usually some grease from the reduction gear case gets into this bearing; but many times it is oil-starved.

On some of these lamps the lower oil cup on the motor is useless. The casting hole into which is screwed the oil cup, and the motor hole into which felt is supposed to go, are so much out of line that there is no chance of getting the felt into the hole. We have overcome this trouble by using a pressure-type oilcan: a good husky squirt into the hole shoots oil in every direction, plenty getting to the right spot. Replacing the oil cup serves only to close the hole—its only use.

Obviously, oil or vaseline should be used in the motor; grease on the gears (in the motor drive compartment) and oil in the other bearings in the gear box. Remember that every moving part must be lubricated: by tracing the drive, starting at the motor, and following through to the positive and negative feeds, no places will be missed. Parts housed in the gear box do not require attention as often as exposed parts in the lamp proper; still, they are often neglected and are needlessly worn due to lack of lubrication, probably because they are boxed up and require removal of a number of screws to get at them.

One Important Exception

One exception to the foregoing must be noted—that is, a ball bearing supporting the rotating part surrounding the positive carbon. The balls in such a bearing fit very tightly in the races, and anything that gets between the balls and the race—such as carbonized oil or a flake of graphite—would cause such great pressure that the bearing would soon fail. As a result, this particular bearing is never oiled.

Now, I do believe that vaseline would not hurt this bearing; but I am not *positive* that it would not carbonize, even to an infinitesimal degree. Having been afraid to try it myself, I do not recommend its use. If vaseline should carbonize—well, it would be just too bad.

All high-intensity lamps have some sort of flue to carry off fumes, but some do not utilize forced ventilation. A draft of air through the lamp will serve to cool the parts, making lubrication easier and preventing the parts burning up. As for the lamp itself, we all know that we cannot get too much air through it; but we must watch the light. We quick reach the point where the light starts to flicker—an intolerable condition.

Inadequate Lamp Ventilation

Several outstanding projection men have frequently asserted that not even the modern lamps are properly ventilated. With little experimentation, it will be found that much more air can be forced through the lamphouse in certain cases than in others, without causing flicker, depending upon how and where the air enters the housing. Two identical lamps in the same room will give widely varying results. Thus, experiment is the only means of establishing the best conditions for a given lamp.

(To be concluded)

COLOR IN MOTION PICTURES HELD DISTRACTING

THE business of the film industry is the sale to the public of screen entertainment in the form of stories. No such story can give satisfaction, can earn the word-of-mouth advertising which makes it a successful commercial venture, unless it holds the attention of the audience, unless it is sufficiently entertaining to keep audience attention continuously on the fate of the people whose affairs it is relating. Obviously, the easiest way to accomplish this is to avoid the intrusion of distractions, to give the audience nothing except the story to think about and make all its individual elements unobtrusive as possible.

Photography Unduly Emphasized

Photography, as one of the most important elements, must not be given such prominence as disturbs the harmony of the whole by virtue of attracting attention to itself and away from the story. The ideal photography to gain the desired end is that in gradations from black to white. It can achieve sufficient beauty to add aesthetic value to such scenes as are strengthened by it, thus being absorbed by the story and becoming part of it. Beauty on its own account is a disturbing element in a screen creation.

Color is a decided distraction. The greater perfection it attains, the more arresting its beauty becomes, the more will it lessen the box-office value of pictures containing it by attracting attention to itself and diverting the attention of the audience from the one thing the film industry has to sell—stories which derive their commercial value solely from their power to hold attention.

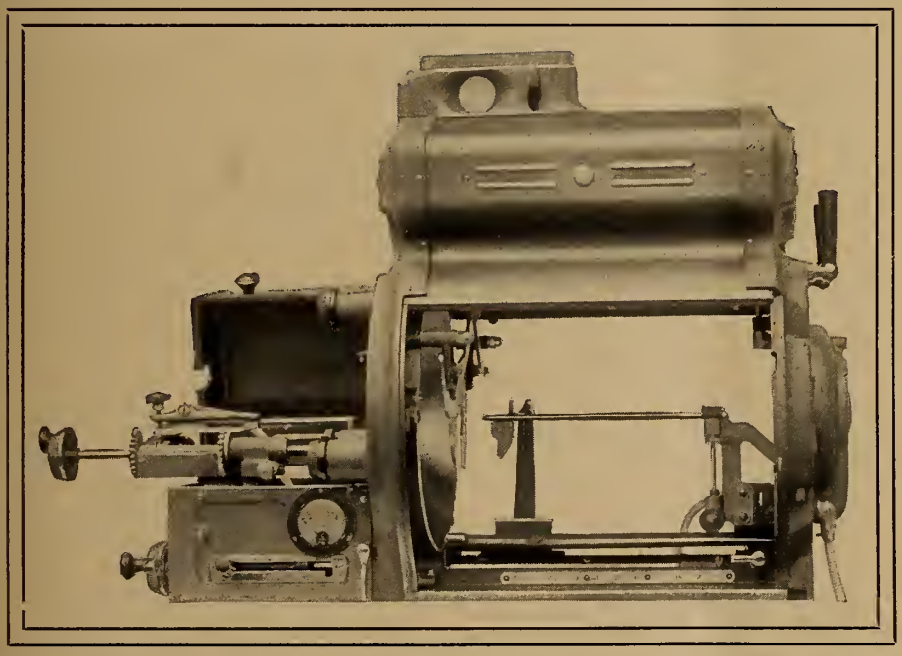
Shakespeare's question about liquor—"Why do men put poison in their mouths to steal away their brains?"—might be paraphrased: Why do producers put poison in their pictures to steal away their box-office value? Yet they do it, deliberately and at greatly increased cost to their pictures. The folly of it is on a par with the folly of "eomedy relief" to induce laughter where there should be none.

Color an External Element

The mood of a screen creation is what holds it together and assures unbroken continuity of audience interest in the incidents of which it is composed. It is the preservation of the mood, therefore, which gives a picture its box-office value, which makes it talked about and earn profits for its makers. The mood of a screened story is set by its internal elements, its human quality, its power to make us laugh, cry or thrill. None of these is even remotely related to such a purely external element as color photography. Just as the audience, to derive entertainment from a motion picture, must imagine the shadows on the screen are real people, so can it imagine the black-and-white shades are real colors.

The strength of screen entertainment is the play it gives the imagination, the illusion of reality it creates. Reality breaks the illusion; yet the film industry applauds the efforts of Technicolor to achieve even greater reality in its color process.—*Hollywood Spectator.*

BRENKERT ENARC
ARC CONTROL FACTORS



Brenkert Enarc operates at high efficiency over a wide range of arc currents. Contributing factors to this excellent performance are the method of magnetic influence on the arc and the method of motor speed control. For steadiest arc burning the magnetic influence on the arc should vary with the arc current. This is accomplished on the ENARC by an electro-magnet whose strength is controlled by the arc voltage. Increase in arc current increases arc voltage, which on the ENARC in turn increases magnetic strength.

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FEATURING

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3. Secondary taps to permit a wide range of adjustment in arc-voltage and current to meet individual needs.
4. Copper Oxide Rectifier Unit assembly. A permanent rectifying device of proven reliability and safety, which will operate indefinitely without attention or replacement.
5. Blower system (patented) for forced ventilation of Copper Oxide Unit. By means of this blower system, the units are maintained at approximately room temperature. This feature will be appreciated by the projectionist.
6. Heavily constructed blower motor, equipped with oversize ball bearings, specially lubricated at the factory and capable of giving many years of service without further lubrication or attention.
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Hundreds of General Electric Copper Oxide Rectifiers For Projection Service have been installed in theaters the country over. Improved projection, reduced current-costs and increased profits have resulted in every case.

G-E Copper Oxide Rectifying Units are available in two standard sizes: 40-50 amperes for 6-7 mm trim; 50-65 amperes for 6.5-8 mm trim. Other ratings may be built to order. For operating a spotlight, two units can be connected in series.

Improve projection in your theater to increase attendance and profits. At the same time, reduce current-costs. A G-E Copper Oxide Rectifying Unit saves from 5 to 10 cents per hour in cost of current. For more complete details, mail coupon today.

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What About 16 mm. Projection?

THE projectionist craft is making a first-class mess of its operations in the 16 mm. industrial and educational field, according to reports reaching I. P. from credible sources. Investigation by I. P. within even a limited area substantiates the assertion of those companies handling industrial and educational films that the craft is not paying off for value received in the form of wages.

Extension of 16 mm. field activities, particularly for industrial trade showings, has opened up a vast new field for cultivation by projectionists. That the craft is not unaware of these employment possibilities is attested to in fulsome measure by the record of proceedings of national, sectional and state conventions of the organized craft during the past several years. Exploitation of the labor-placement opportunities thus provided has been and still is considered by the craft as a natural heritage, a God-given right. Maybe it is; but what about competency?

As is the case in too large measure in the professional field, the craft has again exhibited its apparently ineradicable tendency to water the leaves and ignore the roots. The craft's objective is jobs, and once this goal is attained, nothing else seems to matter—certainly not competency.

Has the employer (we nearly said "victim") been induced by any manner of means to sign a contract for a 16 mm. crew? Certainly. Then to Hell with anything else—so long as the boys get paid. The fact that the crew assigned to operate the equipment knows nothing at all about a 16 mm. outfit is a mere inconsequential detail, mentioned only by those nuts who talk and write about better projection. Is the employer complaining of the quality (?) of worked delivered? Well, to Hell with him, too, because ain't we got his John Hancock on a contract? Next year is time enuf, time enuf . . .

For example: one large user of 16 mm. industrial films reports (and the report has been checked and verified) that projectionists assigned to his showings, at full scale and more, not only didn't know the first thing about assembling and knocking-down equipment but actually didn't know the first thing about its operation. The screen, the accompanying sound equipment, the run of cable, the light source (whether carbon arc or Mazda) the projector mechanism—all of these were as foreign to the projectionists as is Patagonia to the United States. This from "projectionists" of the organized craft!

To make matters worse, the projectionists, instead of admitting their unfamiliarity with the equipment and trying to learn something about it in the limited time available before a showing, proceeded to work up a fine froth of indignation and became abusive when the employer's agent called for service. In some instances cited, the crew dug up that old bromide about having been sent on the job by the organization and being able to stay there until Hell froze over. Further, if the employer didn't like it, what was he going to do about it?

Not infrequently, lecturers assigned to 16 mm. film showings have been compelled to dispense with the accompanying talk in order to operate the equipment—while the "projectionist" assigned to the job stood idly by! This surely is great stuff and a fine prestige-builder for the organized craft in both the professional and non-theatrical projection fields. Such charming manifestations of craft intelligence and competency cannot fail to endear projectionists to employers throughout the industry.

The correction of this condition promises to be particularly difficult because—unfortunately for the ultimate welfare of the craft—most of this work consists of trade showings which are of vital importance to their sponsors, who exert every effort to have them go off without a hitch. A majority of such showings are in the nature of "spot stands," so to speak, timed so as to tie-in with large national advertising campaigns, seasonal promotional efforts, etc. All of which makes it very important that there be no hitch, such as Labor conflict. We term this situation unfortunate because otherwise the craft might feel less secure and more anxious to deliver quality work.

Now, the 16 mm. field is not a playground, nor is the equipment a toy for child-minded adults. Neither is it a "lucky break" which happens along every so often to ease the unemployment situation in a given locality. To hear craft leaders bellowing their heads off to obtain the work, and to read their pronouncements as to how best to cultivate and, once obtained, to hold this type of work is to have dispelled immediately the idea that there is any fooling about the matter.

There is no implication herein that *all* projectionists assigned to 16 mm. showings are incompetent. Not at all. But unfortunately, the few who do have some rights in the premises other than a job slip merely serve to emphasize the shameful inefficiency of the large majority.

So that's how it is. What's to be done about it? The answer, so it seems, is crystal-clear. Most of these industrial film showings occur in towns having a population of not less than 100,000. Units in such towns should set about immediately to absorb a little knowledge of 16 mm. equipment. Manufacturers will welcome the opportunity to supply such information. In fact, it might be a good idea to train a selected group of men for this type of work, so that qualified personnel would be available at all times, irrespective of their regular posts, which could be filled by substitutes for a day or more. Certainly it is most unwise to assign just anybody off the bench to 16 mm. jobs merely because he is a member and has a license.

Of course, all projectionists should familiarize themselves with 16 mm. equipment; and to this end I. P. will inaugurate shortly a series of explanatory articles relating to the better-known standard equipments. Meanwhile all projectionist units should have several qualified men ready to step into any 16 mm. job and put on a show worthy of the title "projectionist," creditable to the organization and fair value to employers paying the freight.

Everything that has been said to date relative to the need for competency in the professional theatre field applies with greater force to the 16 mm. field, because the position of the craft in the latter field is not nearly so well-defined as it is in the former. The 16 mm. field offers the craft a marvelous opportunity to extend its influence, and nothing that will hinder even slightly craft progress in this direction should be countenanced by craft officials.

The continuance of the present sloppy work by a majority of those assigned to 16 mm. jobs will result not only in the loss of this important employment but will injure considerably the prestige and standing of the craft in the theatre field.—J. J. FINN.

STEP-BY-STEP ANALYSIS OF SOUND REPRODUCING EQUIPMENT

By *AARON NADELL*

XX. Simplex-Acme TA-62 Sound Equipment

SOME very modern features are included in the amplifier diagrammed in Fig. 1 which distinguish it from many of the circuits examined previously herein. The power supply arrangements are conventional, however, and can readily be traced in the lower right-hand corner of the drawing.

The power input is from the right, marked "line," with the 110-volt a. c. wires passing through the cut-out box, TA 3110, which is mounted on the amplifier cabinet. Just left of the input are shown the taps of the line voltage compensation switch. When contact is made to the tap marked "105," fewer primary turns are operative in the power transformer, thus increasing the ratio between primary and secondary turns and producing higher secondary voltages, compensating for a low voltage line. The reverse condition applies when the switch is set at the "120" tap to suit medium and high line voltage.

The transformer is wound with three secondaries, of which the left-hand secondary (center-tapped to ground) supplies heater current to all the amplifier tubes. In accordance with modern practice, the connecting wires are not shown. The amplifier tube designations indicate that they are all six-volt tubes (their code numbers start with the figure "6"), and their heaters are merely wired in parallel to the transformer terminals marked "X" "X."

The right-hand secondary of the same transformer heats the emitters of the two 83V. rectifier tubes. These heaters are wired in parallel to that winding. It will be noted that the structure of the 83V. tube includes two heaters internally connected in series, but this has no bearing on the wiring of the amplifier.

Each 83V. contains two plates, with the tubes connected as full-wave rectifiers in an unusual way which tends to eliminate possibility of hum or low voltage arising from a weak tube or from unbalance between the two. Conventionally, when two tubes are used for full-wave rectification, each takes care of one-half of the cycle. In this amplifier, the two upper plates of both tubes, as drawn, function when the left-hand end of the central or plate secondary is positive, and the two lower plates function on the other half-cycle. At all times, therefore, weakness in one tube is compensated for by the action of its partner, in distinction from the more customary arrangement in which a weak tube limits rectifier output during each half-cycle and thus makes filtering more difficult by reason of the irregularity in the ripple produced.

The positive output from this rectifier will be found leading off from the right of the right-hand transformer (rectifier heater) secondary, and labelled +430V. That line may be traced right and upward to the filter assembly, where it passes through the filter chokes TA 3082 and TA 3083. The negative terminal of the rectifier is, of course, the grounded center-tap of the plate secondary of the power transformer. Throughout the drawing, therefore, ground will be considered, as it is, equivalent to B negative.

The two chokes of the filter assembly are by-passed to negative by four associated filter condensers—three TA 3030 and one TA 3031. The filter is of the condenser input type—that is, the first condensers are connected to the positive side of the first choke—and those two condensers are by-passed by resistors which may serve to protect them against peak voltage surges and also bleed off their charge slowly (being 75,000 ohms each); thus, this filter assembly is safe to handle after power has been turned off for a short while—another unusual feature.

Thirty volts are dropped in the lower choke coil, as may be seen by the voltage data accompanying the wire branching rightward from its upper end. That wire runs to the center-tap of the primary of the output transformer, and through that winding supplies B current to the plates of the four push-pull parallel output tubes.

Returning to the filter assembly, trace upward through the upper choke, in which the voltage-drop is 93. Inclusion of this second choke not only supplies additional filtering, but effectively isolates the remainder of the B circuits of this amplifier from the B circuits of the power output stage, and thus isolates any B voltage surges that may appear in the output stage at high volume levels. From the upper end of the upper choke a B positive wire (+370 volts) runs up and then left almost all the way across the drawing. This wire henceforth will be called B positive, and the source of B potential for the remaining amplifier circuits.

Just a half inch left of the upper choke coil a wire branches upward from the B positive source and supplies the screen grids (the grids nearest plate) of the four output tubes. These tubes, being 6L6's*, operate as pentodes but have no supressor grids, the supressor effect being supplied by the beam of emitted electrons.

Tracing further left along the B positive bus as drawn, another wire is encountered running upward to supply the plates of the two 6F6 driver tubes.

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* I. P. for June, 1936, p. 22.

Simplex-Acme TA-62 Features in Brief

Cabinet design of console-type, sloping panel, which mounts all controls.

Extreme accesibility of amplifier and rectifier units provided by hinged construction, allowing chassis to be dropped for inspection.

Latest circuit design, using all metal tubes.

All rectifying equipment for amplifier, exciter lamp and speaker field supply centrally located in the same cabinet with the amplifier.

Single a. c. supply switch provides current to entire reproducing system.

Each photo-electric cell is fed into separate input tubes, thus assuring maximum high-frequency response from each p.c. cell circuit.

Faithful reproduction of all frequencies from 50 to 9000 cycles.

Special 18" high-efficiency, low-frequency speakers.

All-range speakers, making unnecessary high-frequency units or tweeters.

Filter network to divide output into two channels, thus assuring the utmost efficiency and acoustic quality.

Outright sale; no rental or service charges.

Built-in soundhead an integral part of projector.

These tubes are operated as triodes, although of pentode construction, since their screen (center) grids are tied to their plates, and act as physical extensions of the plate structure.

Still further left a wire branches upward to supply the plate of the 6C5, and a bit more to the left a TA 3053 resistor links the bus to ground (resistance, 20,000 ohms). Further left still, the supply to the 6F5 pre-amplifier tubes may be traced upward through two resistors, TA 3042, and left to the plate of the upper 6F5, or left, down and left to the plate of the lower 6F5. These plates are in parallel, although the grids of the same tubes are excited by two different input sources, and these tubes therefore serve as a mixer through which the output from either photocell is passed along to the common amplifier.

Tracing still further to the left along the B bus, that wire may be followed downward through three resistors—TA 3041, TA 3045 and TA 3046—to ground. Those resistors constitute a voltage divider, from which 65 volts are tapped off for photocell B supply.

From the bottom of TA 3041 trace left through TA 3043, up (through another TA 3041) and left to the anode of the lower photocell. The anode of the upper cell is supplied through the potentiometer TA 3061, shown just left of the voltage divider. If the slider is set all the way up, the voltages of the two anodes are identical. As the slider is moved downward, the upper photocell will receive less plate voltage. Therefore the stronger of the two cells should be placed in the upper socket (Projector No. 2) and the weaker in the lower socket (Projector No. 1), and the voltage to the upper or stronger cell reduced until sound output from both is equal.

Grid Bias Circuits

Grid bias arrangements in this amplifier are entirely conventional. Consider the two pre-amplifier tubes, 6F5, plate current through which returns to negative through the common cathode jumper, and thence left through the TA 3048 resistor to ground. The grids of the two tubes connect to the negative side of that resistor through two grid leaks, TA 3042.

Plate current of the 6C5 returns downward to ground through TA 3047 resistor, and the grid of that tube connects to the negative or ground end by means of the TA 3042 grid leak.

TA 3052 joins the common cathode jumper of the 6F6 tubes to ground, and the control grids (the grids nearest cathode) of those tubes return to ground through grid leaks connecting to the negative side of that resistor.

The cathodes of the four 6L6 output tubes are wired in common and return left to ground through two paralleled resistors, TA 3054. The control grids (nearest cathode) of the four tubes return through suitable grid leaks TA 3045, and the isolating resistors, TA 3049, to the negative side of the paralleled resistors TA 3054. Thus, in all the tubes of this amplifier control grids are maintained negative in comparison with their respective cathodes.

Speech Circuits of Fig. 1

The upper photocell may be regarded as a source of speech current (fluctuating d. c.) that can be traced to the grid and cathode of the upper 6F5 as follows: from anode through the coupling condenser TA 3022, thence left through the microphone jack as drawn to grid. From the cathode of the photocell directly to ground. From the cathode of the 6F5 left through TA 3033 condenser to ground.

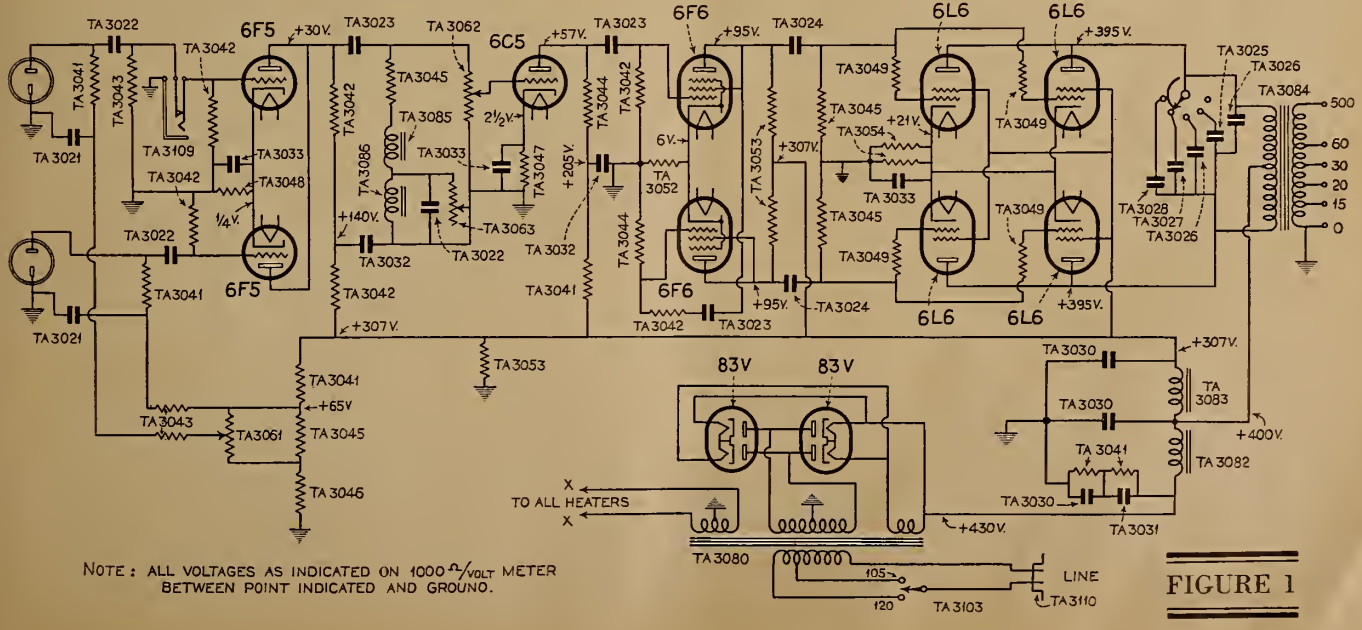
The cathode of the lower 6F5 returns to ground through the path just traced, and the cathode of the lower photocell is grounded directly. The anode of the lower photocell is coupled to the grid of the lower 6F5 through condenser TA 3022.

The arrangement differs from many others only in that two separate tubes are provided for the two photocells, instead of a single pre-amplifier tube with common input; consequently, photocell changes made at one projector will not influence operation if the other projector is running the show at the same time.

The plates of the 6F5 tubes, being paralleled as traced, may be regarded as a common positive pole of a source of amplified speech current, the paralleled cathodes of the tubes serving as the negative pole. The plates may be traced right to the grid of the 6C5 through coupling condenser TA 3023 and the volume control potentiometer, TA 3062. The cathodes of the 6F5's return to ground, as already traced. The cathode of the 6C5 returns to ground (so far as speech current is concerned) through the TA 3033 by-pass condenser. Such arrangements are wholly conventional.

However, the plates of the 6F5's are by-passed to ground through an ingenious low-frequency tone control of a type not found in any amplifier traced heretofore. From the plates of the 6F5's trace to the right through TA 3023 condenser, and then down through TA 3045 resistor and TA 3085 choke, thence right and to ground through tone control rheostat TA 3063. A parallel path to ground exists, from the lower end of TA 3085 choke through the tuned circuit consisting of choke TA 3086 and condenser TA 3022.

If the slider of the tone control is set toward the top, the tuned circuit just mentioned will be shorted out of action; if it is set toward the bottom, that circuit will become effective. The upper choke of the two, TA 3085, being always



NOTE: ALL VOLTAGES AS INDICATED ON 1000 Ω/VOLT METER BETWEEN POINT INDICATED AND GROUND.

FIGURE 1



FIGURE 2

in circuit, limits the action of this control to low frequencies only, and the exact nature of the action upon the low frequencies is controlled by the setting of the rheostat. The high-frequency tone control (traced hereafter) will be found in the output circuit of the amplifier and acts upon the higher frequencies only.

The Phase Inverter

The two 6F6 tubes serve both to drive the output stage and as phase inverters. The output stage is push-pull and requires a push-pull sound source that will swing the grids of the upper 6L6's positive while the grids of the lower 6L6's swing negative, and *vice versa*. Consequently, the speech signal derived from the 6C5 must be split in half, with one half swung 180 degrees out of phase. At the same time further amplification is needed. All these functions are performed by the two 6F6's.

From the plate of the 6C5 trace to the right through the coupling condenser to the control grid of the upper 6F6. Cathodes of both tubes return to ground, of course, one through a condenser, 3033, the other through its grid bias resistor 3052. From the plate of the upper 6F6, in turn, trace left through the coupling condenser, TA 3024, to the control grids of the two upper 6L6's.

But from the plate of the upper 6F6 also trace downward, left through condenser 3023 and resistor 3042, and up, right, up and right to the control grid of the lower 6F6. Since the speech voltage of the plate of any tube is 180° out of phase with the grid voltage, the grid of the lower 6F6 has thus been supplied with signal input 180° away from the signal input of the upper 6F6.

However, another requirement still must be met. The grids (and therefore the plates) of the two 6F6 tubes must not only be out of phase but voltage outputs must be equal. The input to the grid of the lower 6F6 has been aided through the amplification provided by the upper 6F6, and with its own amplification added, signal output from its plate will be greater than signal output from the plate of the upper tube. To avoid this, the line running to the grid of the lower 6F6 is continued upward through TA 3044 resistor to ground. Hence this line serves as a by-pass to ground for speech current; and current as well as voltage will flow in resistor TA 3042, which is in series with the grid of the lower 6F6.

This voltage-drop offsets the amplification derived from the upper 6F6—not the input to the last stage of the amplifier, but so far as input to the lower 6F6 is concerned. The output delivered to the lower 6L6's by the lower 6F6 is thus brought down to equal the output delivered to the upper 6L6 by the upper 6F6, and full-wave, push-pull input is supplied to the power stage.

The Output Circuits

The plates and cathodes of the 6L6's may be regarded as the poles of an a. c. generator delivering speech a. c. greatly amplified to the output transformer. The plates of the two upper tubes may be traced directly to the upper end of the output transformer primary; and the plates of the lower two tubes to the lower end of the same winding. The cathodes of all four tubes ground leftward through condenser TA 3033. The center-tap of the output transformer primary may be traced to ground left, down and left through condenser TA 3030.

The drawing shows three condensers—3026, 3027 and 3028—shunting the input to the power transformer, thus reducing high-frequency response. Two other condensers—TA 3025 and another TA 3026—are open-circuited and inoperative in the drawing, but can be paralleled by means of the rotary tap switch, still further reducing high-frequency sound. Or all of them, except for the right-hand 3026, can be open-circuited by means of the same switch, increasing high-frequency response. This arrangement is the high-frequency tone control of the amplifier.

The secondary of the output transformer is tapped for any desired output impedance.

One of the most interesting and important features of this amplifier is the physical construction and arrangement illustrated in Figs. 2 and 3, which make every part and wire instantly accessible for servicing.



FIGURE 3

This unique construction, providing a hinged arrangement by which the chassis can be dropped, permits instantaneous inspection of entire amplifier and greatly facilitates servicing.

'Discomfort' and 'Blinding' Glare

A brilliant bare lamp located within 10 degrees of the line of vision produces both discomfort glare and blinding glare. If the lamp be surrounded by a large white-glass enclosing globe, the discomfort glare will be greatly reduced, possibly to the point where one is no longer conscious of it. Blinding glare, on the contrary, remains unchanged save for such small reduction as is incident to the light absorption of the globe.

To further clarify the relationship between the two types of glare, let us again assume the brilliant bare lamp located within 10 degrees of the line of vision. Both discomfort glare and blinding glare are strongly present. By placing a piece of very white cardboard behind the bare lamp, the discomfort glare is reduced without changing the blinding glare. Let us now substitute a bare lamp of one-fourth the size and a dead-black background. Discomfort glare is increased but blinding glare is reduced to half of its former value.

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• Letters to the Editor •

SUPREX ARC MAGNIFICATION RATIO

My recent letter commenting on Suprex arcs (I. P. for April, 1936, p. 26) apparently has been misconstrued, since you state that "the trouble is not mechanical" and doubt whether "mechanical contrivances would effect improvement." It is foolish to believe that optical deficiencies could be overcome by mechanical contrivances, and that was not my contention. The only point of consideration is "the extreme difficulty encountered by several complainants in holding the Suprex arc spot on the aperture."

The magnification ratio of my reflectors might be incorrect, but I still contend that by the aid of the aforementioned mechanical contrivances and adjustments I do not experience any difficulty in holding the spot on the aperture, and I assure you the spot is drawn as small as possible to obtain the best results.

Magnification ratio, as I understand it, is the number of times the diameter of the crater is enlarged on the aperture, which is governed by the distance of the crater from the reflector and its curvature. To my way of thinking, these are fixed objects when the arc is burning.

Factors Governing Spot Area

Let us assume that these objects are fixed in stationary relationship to each other—that is, the reflector being set to obtain a small fixed spot on the aperture, the crater being in the same constant relationship with the reflector, and the specified arc voltage for a given carbon combination remaining constant—under those conditions will you please explain to me how the spot on the aperture could possibly be unsteady or caused to move around by having improper magnification ratio.

The lamp manufacturers say: "If our lamps are operated under the above conditions, no trouble will be experienced in holding the spot on the aperture"—with which I would readily agree; but the Suprex lamps I am operating would positively not hold a steady spot on the aperture without the assistance of the aforementioned improvements, and I stand by that assertion to the very last with ample proof, with or without proper magnification ratio.

If the craft were to blame for results obtained with Suprex lamps, I would readily submit details, but the fault lies with the manufacturers who sell the lamps.

G. F. Patterson
Tulsa, Oklahoma.

This discussion requires first a definition of terms. The phrase "holding the spot on the aperture" is unfortunate and misleading, because once the aperture is covered there should be no difficulty experienced in "holding" the spot thereon. A majority of Suprex lamps never did fill the aperture, thus precluding any possibility of "holding" the spot there. Suprex arc troubles are traceable to optical rather than mechanical deficiencies, and no mechanical adjustments can correct a condition that is basically wrong.

With *all* projection lamps, not alone Suprex, the aperture of .600 X .825 inches must be *completely covered diagonally*. With the 7 mm. carbon none of the first Suprex arcs ever satisfied this requisite. Why? Because the optics (magnification ratio) were wrong, impossible of correction by any amount of "mechanical adjustment." With the 8 mm. carbon, the manufacturers just barely managed to cover the aperture *diagonally*. Even so, all the other factors entering into operation of this very critical arc had to be perfect; but with the 7 mm. carbon, even if all other factors were perfect, it was impossible to get aperture coverage.

It should be remembered that the discussion here centers around "field," not on any effort to "hold" the spot on the aperture.

Intense Competition Responsible

Now, if the lamp manufacturers knew of these Suprex arc deficiencies, it may be asked, why did they tolerate them? The answer is that the Suprex arc was introduced under the aegis of intense competition and a world of high-pressure salesmanship. Lamps were bought on the basis of competitive tests, side by side in the projection room, and manufacturers were concerned not with aperture coverage ("field") but with pouring the greatest amount of light through the *center* of the aperture, so as to insure the best possible meter reading.

The lamp manufacturers knew that with 7 mm. carbon they could not fill the aperture *diagonally*, and they also knew that they were just barely getting away with it when using the 8 mm. carbon. Knowing these things, they still persisted in succumbing to the competitive spirit, went in for high-pressure salesmanship and, in the absence of a rational agreement among themselves relating to improvement, depended upon the gullibility of purchasers to carry off the bluff. This surely is another splendid tribute to that grand old American individualism and competitive spirit about which we hear so much these days.

Naturally, I. P.'s function is to lighten up such dark corners as were presented by this situation, and it proceeded to do just this. Of course, it wasn't a pleasant task: and the manufacturers didn't particularly relish the free advice. But it effected improvement, for today the lamp people have corrected this deficiency by improving lamp optics and furnishing different mirrors for either 7 mm. or 8 mm. carbon operation.

All of which brings us back by a devious route to Mr. Patterson's comments. We repeat: if Mr. Patterson used a 7 mm. carbon, he never did get aperture coverage diagonally. If he used the 8 mm. carbon, he just barely got coverage. Once his lamps were set up, no amount of "adjustment" would improve matters. Even with the 8 mm. carbon all factors would have to be perfect for efficient operation. These factors are:

(1) Mechanical (feed)
(2) Electrical
(3) Optical
(4) Carbon

Possible Corrective Measures

Some projectionists may prefer grouping 1 and 2 above. The point is, however, that if any *one* of these factors is wrong, the entire process suffers and the projected image is what the French might term "lousay." Although it is extremely difficult to understand just what "mechanical adjustments" would help Mr. Patterson once his original setup were made, he might have resorted to either or both of the following expedients:

(a) Voltage Regulation
(b) Control Adjustment

Assuming that Mr. Patterson is correct in ascribing the difficulties enumerated hercin to the shortcomings of lamp manufacturers, we still fail to recognize this statement as a valid reason for withholding details of his "mechanical improvements" from the craft. The whole purpose—the only purpose—of this discussion is to give the matter a thorough airing and let light into the dark corners. Our correspondent's willingness to participate in this discussion, while insisting upon withholding details of a means for correction, is hardly understandable—irrespective of where the fault lies.

Scheduled for the next issue of I. P. is an article which will discuss the merit of a currently popular lamp conversion process, incorporated in which, it so happens, will be a detailed discussion and sketches relating to the topic of magnification ratio.

I. P. Readers Please Note

Subscribers are again urged to notify I. P. of any change in address, even if for only a limited period, as far in advance of the actual change as is possible. Post Office advices on undelivered copies constitute a needless expense and frequently do not include the subscriber's new address.

Assure receipt of all copies of I. P. by early notification of change of address. A penny postcard, upon which appears your name and the old and new addresses, will suffice.

Cooley on Cooling Plates

The waffle-type, metal cooling plate used on the Regular Simplex mechanism gets hot enough while projecting 2.000 feet of film to retain the heat, thus

making it dangerous to immediately thread another reel into the projector. If the film comes into contact with the cooling plate in the process, a fire is almost certain to ensue. The moral is that an asbestos cooling plate is better than a top magazine full of ashes.

S. Cooley
Manchester, N. H.

The moral is, too, that the film should not come in contact with the cooling plate. If the film gets pig-headed and insists upon so doing, then an asbestos plate is a swell idea. Incidentally, we thought that those Boston fellers once ran some tests designed to show the heat-retention characteristics of mechanisms after running film with Suprex arcs. We never really hoped to lay both Cooley and the Boston fellers in the aisles in one breath.

More 'Conversion' Data; A Distinguished Visitor

Relative to your editorial in I. P. on the conversion of low-intensity lamps by substituting larger reflectors ("An 80% Increase in Light for Only $30,"—June, 1936, p. 19): we have installed them here and find that they are a great improvement. Naturally, the light is not increased by 80%, but the process does enable us to increase the light, with a clear, white, even light over the entire screen. I would say that this is money well spent, although the results are not comparable with Suprex.

We were visited recently by the celebrated F. H. Richardson, who gave us a lecture (or sumpthin). After leaving he proceeded to give us a "riteup" (by Gad) regarding the distance of our screen from the front row of seats. Having been in the picture business since 1913 (dad bing it) I fail to see where projectionists can rebuild the theatres in which they happen to work to suit themselves. Incidentally, "Father" Richardson's lecture started, proceeded and ended with the phrase, "I am ashamed of you."

Frank J. McInrow
Warners' Majestic Theatre
Mansfield, Ohio.

As previously stated, this "conversion" process will be discussed in detail next month. In passing, it might be mentioned that whether more or less light be obtained from a low-intensity lamp, the *quality* of the light remains the same. Also, new reflectors are available any time to those who desire to purchase them. More about this in I. P. for Sept.

Deficiencies in Model S.M.P.E. Room Layouts

I have just had occasion to consult the model projection room layouts, prepared by the Projection Practice Committee of the S.M.P.E. and published in your Sept., 1935, issue, p. 16, and I note what appear to be deficiencies therein. Witness:

1. No light has been provided upon entry into the room. This light should be located in the center of the room, controlled by a pair of three-way switches, one at each of the two entrances. According to the layout—or, rather, the omissions therein—one would have to grope in the dark for a string to pull.

2. No outlet has been provided for an electric clock, no longer a luxury but a projection room necessity.

3. A lighting panel should be provided, containing branch circuit fuses, for the projection room outlets only.

While these are personal opinions, I think they will find agreement among the craft generally.

George A. Bishop, Jr.
Fall River, Mass.

Considering these comments in order: (1) Of course there should be three-way switches at entrances. The drawings referred to don't show these switches, although there is nothing about the layout to prevent their inclusion in any room. (2) The idea about the room clock is a good one. Specifications show no outlet for same because positioning is largely a matter of personal preference. (3) A panel is shown in the specs., although not fused as Mr. Bishop suggests.

Although I. P. is not authorized to speak for the Projection Practice Committee, it should be mentioned, in fairness to this group, that these room layouts were intended only as temporary specs. to fill an urgent need at the time, two projector manufacturers having filed notices of intention to so alter their designs as to necessitate a radical revision of layouts in the near future. Unquestionably the Committee will make available shortly permanent specifications which will include these changes.

Insulation, Gear Lubrication, Film Cleaning, S.M.P.E. Reports

Could you answer the following questions for a new subscriber who appreciates greatly the wealth of information in each issue of I. P.:

(1) What is the best insulation to be placed between projector bases and a concrete floor?

(2) Do you approve of the use of graphite on gears in projector mechanisms?

(3) What is the most practical method for projectionists to clean film, and does a lot of cleaning injure the emulsion?

(4) Relative to the model S.M.P.E. projection room layouts, which type is the new Super Simplex stand?

(5) What is the best of the aforementioned layouts for a room 10′ x 10′ x 18′, with room for two projectors and an effect machine?

(6) To whom are the S.M.P.E. reports available?

Joseph W. Spradling
Bancroft, Iowa.

Answering the foregoing queries in order: (1) None. Projectors should not be mounted on a base having even slight resiliency. (2) No. Graphite has a tendency to lump up and may cause trouble in gears. Use a medium-heavy grade of automobile oil. (3) It is the function of the exchange, not the projectionist, to clean film, which should be delivered clean. However, a little carbon tetrachloride solution will answer the purpose. Excessive cleaning eventually will affect the emulsion; but this is hardly a projectionist's concern. A clean mechanism is the best insurance for clean film.

(4) A new stand for the Super Simplex is now in work and will be ready shortly. (5) On the basis of always aiming high, the medium-size layout. (6) S.M.P.E. reports are printed in the *Journal* which is mailed monthly to all members. Attractive is associate membership at $5 annually.

'Regular' Simplex Off Market, Replaced By 'Super' Head

MOTION PICTURE projection history was written on August 1 when the Regular Simplex rear- and front-shutter projector mechanisms were withdrawn from the market, as a result of the marked preference of the trade for the Super Simplex mechanism. The latter is now the only type of projector mechanism being marketed by International Projector Corp.

At the same time, and to further encourage more widespread use of modern projector heads, the list price of the Super Simplex mechanism was reduced to $650, which figure reflects a reduction of almost $200 since this mechanism was introduced. The new price approximates that of the old Regular rear-shutter mechanism.

Among the improvements of the Super Simplex over the old Regular mechanism are: a heavy main frame, hardened intermittent, burnished bearings, hardened shafts, built-in rear shutter, heavy cast iron film trap, removable gate, substantial lens mount, heavier and larger enclosing covers, etc. Greater ease of operation, reduced maintenance costs and improved dependability as a result of these improvements are counted upon by the manufacturer to more than offset the moderate additional cost of the Super mechanism.

The old Regular Simplex mechanism, like so many projectionists still active in the field, sort of "growed up" with the motion picture business, having been a projection standby for more than 26 years. Now it is considered to have outlived its usefulness; but for nearly three decades it ground out countless billions of feet of film on projection firing lines throughout the world. Many projectionists will recall the Titanic struggle between Simplex and Powers for dominance in the projection field, the former finally emerging the victor.

Uniform National Projection Laws Proposed by Noted Craftsmen

Projection Practice Committee of the S. M. P. E. Cites Shortcomings in Design, Installation and Operation of Equipment as Direct Result of Mass of Conflicting State and Local Regulations, Based on Insufficient Knowledge of Projection Process. Other Committee Activities.

THE Committee has embarked upon what is probably its most important undertaking to date—the establishment of standards for the installation and operation of visual and sound projection equipment. When this work is completed, and considered in connection with the standard projection room layouts already established by this Committee, there will be available to the industry a valuable reference source covering the entire projection process.

Heretofore, the design, installation, and operation of projection equipment have been seriously hampered by a multiplicity of varying local and state regulations, a majority of which are undoubtedly well-intentioned but which sometimes reflect a regrettable lack of knowledge of the projection process on the part of their sponsors. This situation operates to defeat the best efforts of manufacturers, exhibitors, and projectionists to attain better projection results; and it also permits the rather widespread use of decidedly inferior equipment and encourages sub-standard installation and operating practices.

It is a not uncommon experience, for example, for a manufacturer to gain approval for his product in one state, whereas an adjoining state withholds approval and enforces changes in design which occasion unnecessary expense and impaired operating efficiency. Indeed, there very often exists a sharp distinction between state regulations and those promulgated by municipalities therein. Exhibitors are confronted with the same difficulties, and equipment having the approval of one city is often unacceptable to another city in the same state.

Regulations Help, Not Hinder

Members of the Committee who have had long experience in practical projection work are agreed that the absence, rather than the existence, of specific regulations in many states is highly undesirable, because the conditions to be met in such territories frequently lie within the province of some local official whose personal opinions are not consistent with generally approved procedure. There may then develop friction between the authorities of a given municipality wherein one division of the city government disagrees emphatically with another.

The Committee has set for itself the task of establishing projection standards which, it is hoped, will be acceptable not only to the Society but also to the nationally recognized regulatory boards. This goal having been attained, such standards could be submitted to the Sectional Committee on Motion Pictures of the American Standards Association.

Should complete success crown the efforts of the Committee in this direction there still would be lacking means for assuring their adoption by the various states, cities, and towns. It is assumed, however, that the prestige and authority accruing to the standards through the approval of the aforementioned impartial and non-commercial organizations would exert a potent influence and go far toward inducing favorable action by a vast majority of the authorities.

The efforts of the Committee are directed naturally to improving the quality of the screen image, and of sound; but this objective can be achieved only after painstaking consideration of the many diverse elements involved in the projection process, ranging from the film stock itself through the entire chain of visual and sound projection equipment units to the screen.

Obviously, this task will impose a severe strain upon the resources of the Committee. To this end the Committee extends an appeal to the industry generally and to the full Society membership in particular for cooperation in submitting any data having a bearing upon this investigation. Other committees of the Society which are interested in related topics have already been informed of this program and have been asked to cooperate.

The Committee, as a matter of technical co-ordination, will endeavor to obtain from each branch of the industry information on projection equipment and methods and their bearing on other devices and processes used by the industry. These data should be widely disseminated in all quarters where they may be used to advantage to increase efficiency and economy.

Current Committee Activities

Other topics which will continue to have the close attention of the Committee are:

1. Further refinement and extension of projection room layouts for small, medium, and large theatres.
2. General auditorium lighting, a topic which invites particularly close attention at this time as a result of the general marked improvement of projection light sources during the past two years.
3. Determination of the correct mirror magnification ratio to obtain an acceptably uniform spot for the standard projector aperture with the Suprex arc.
4. Illumination and sound transmission characteristics of the screen.
5. Types of screen masking.
6. Suitable starting acceleration of motors driving the projectors (avoidance of excessive strain and consequent damage to equipment and film).
7. Projection illumination with reference to color-film.

The last topic is particularly important at this time because of the possible increasing use of color film by the industry. The resultant color upon the screen is dependent in large measure

(*Continued on page* 29)



HARRY RUBIN
Chairman, Projection Practice Committee, S.M.P.E.

THE W. E. 86-TYPE AMPLIFIER

By *V. M. COUSINS*
MEMBER OF THE TECHNICAL STAFF, BELL TELEPHONE LABORATORIES

This new amplifier is one unit in the modernization program now being furthered by Erpi in its theatre installations, including elimination of the 200A panel, installation of the new multicellular speakers, and the use of the 300A and 262A tubes—all of which have been described in detail in these columns.

AMPLIFY: To enlarge or to increase in scope. As defined thus in the dictionary, the word amplify has ordinarily been used to describe the rhetorical process of enlarging an idea, or perhaps of expanding a description or discussion. Whatever the ordinary usage has been and to whatever extent the enlargement has been carried out, it is safe to say that the amplification involved has not even approached the amplification obtained in many types of vacuum tube amplifiers used in various forms of electrical communication and transmission.

"To enlarge or increase in scope" is almost ludicrously inadequate to describe a process that increases the electrical energy in a circuit tens or hundreds of billions of times, values which are required of amplifiers in numerous circuits at the present time.

Sound picture and public address systems require amplifiers capable of providing energy increases of the order of ten billion times, or gains of 100 db, to increase the very small amount of energy received from the photoelectric cell, microphone, or phonograph reproducer to values capable of operating the loud speakers in a theatre or hall at the level required for proper sound reproduction. Besides providing this large amount of amplification for the signal currents, the amplifier must provide—if operated from alternating current—energy losses between the power and voice circuits of a similar order of magnitude, so that crosstalk from power circuit to voice circuit will be maintained at an inaudible level.

Gain and Output Level

To make available an economical, high-quality amplifier for sound picture and public address systems, Bell Telephone Laboratories has recently developed the 86A, B, and C amplifiers. Incorporating the latest developments in vacuum tubes, transformers, and other elements, these amplifiers provide a gain of 98.5 db and an output level of approximately 15 watts. The circuits and mechanical arrangement of the three amplifiers are essentially the same; they differ chiefly in being arranged for different power supply frequencies and output impedances, in order that they may be adaptable to a wide range of uses.



FIGURE 1

An installation of a 1086A amplifier in a motion picture theatre. An 87A amplifier is mounted on the lower section of the rack

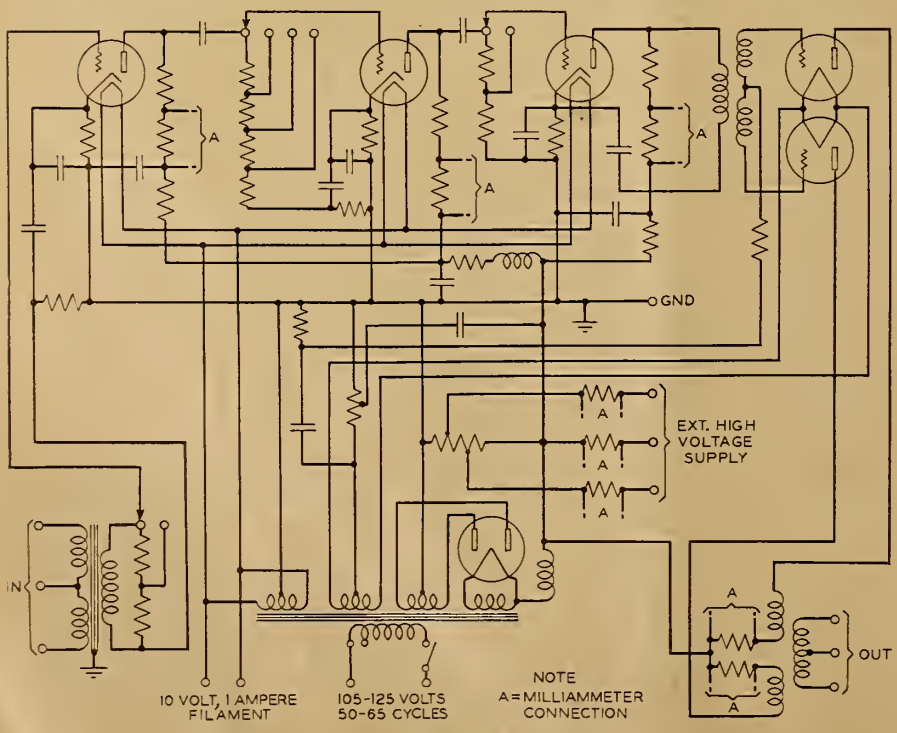


FIGURE 2

Simplified schematic of the 86-type amplifier circuit

As shown in the schematic of Fig. 2, these amplifiers have four stages: the three preliminary stages employing 262A vacuum tubes* resistance-condenser coupled, and the power stage employing two 300A vacuum tubes† in a push-pull arrangement. Transformer-coupling is used for the input to the first stage, and as input and output for the power stage. The amplifiers are entirely a. c.-operated: the plates being supplied from a 274A vacuum tube, which rectifies the high voltage supplied by the power transformer, and the filaments being operated on low voltage obtained from the same transformer.

The power transformers of all three amplifiers are designed to operate from a primary supply voltage between 105 and 125 volts. The A and B amplifiers are designed for 60-cycle circuits, and the C amplifier for either 50 or 60 cycles. All three may be operated con-

* I. P., *February*, 1933, *p.* 21.
† I. P., *July*, 1936, *p.* 20.

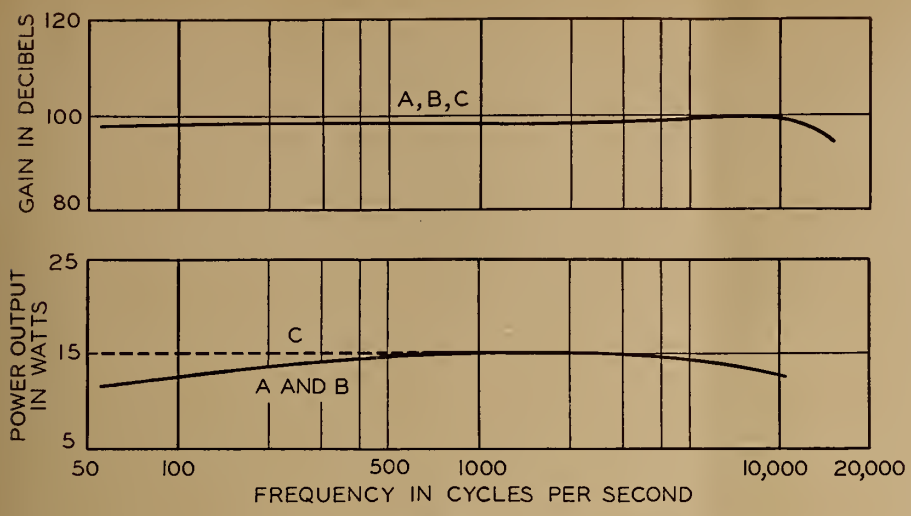


FIGURE 3

Characteristic curves for the 86-type amplifiers: above—gain-frequency; below—power output

tinuously at room temperatures as high as 110 degrees Fahrenheit.

In a considerable number of sound-reproducing systems, auxiliary amplifiers or circuits are used for which small amounts of plate and filament energy are required. To make it possible to supply this energy, the 86-type amplifiers are provided with excess power capacity and suitable connections from which one ampere at ten volts may be obtained for filament supply, and rectified and partly filtered plate currents of 5, 7.5, or 10.5 milliamperes at 400, 190, or 85 volts, respectively. This is sufficient to energize three W. E. 80A or 62A amplifiers. Two small filter units, the 714A and 716A apparatus units, have also been designed for providing the additional filtering required by the high-voltage energy used for auxiliary amplifiers.

To aid in installation and servicing, means have been included in the amplifiers for measuring the space current of each vacuum tube and external "B" supply circuit. Current shunts have been soldered into each of these circuits and a rotary switch provided by which a special meter, known as the KS-7535, may be connected to any of the shunts.

All three amplifiers are designed to operate from a 200-ohm impedance, which is common practice for amplifiers of this type, but the output impedances differ. The 86A and 86C amplifiers operate into a load impedance of either 6 or 12 ohms, while the 86B operates into either 8 or 500 ohms. Continuous adjustment of gain is not provided, but fixed attenuators have been placed in the grid circuits of the three preliminary stages so that the gain may be adjusted over a wide range in steps of 5 db. These attenuators may be connected into the circuit by means of taps shown in the diagram.

Five-decibel attenuation is provided in the first stage; 10, 20, or 30 db in the second stage, and 10 db in the third stage. Connections from these taps are brought to a terminal strip beneath the chassis where connections for the desired gain may be made. In addition, one or two of the preliminary stages may be cut out of the circuit. By these means the gain of the amplifiers may be adjusted in 5 db steps from 38.5 to 98.5 db.

Characteristics; New Tubes

Characteristics of the new amplifiers are shown in Fig. 3. The gain-frequency characteristic is the same for all three types, and is essentially flat from 50 to 12,000 cycles. The power output characteristics of the 86A and B amplifiers are similar, showing an output level of 15 watts over the major portion of the frequency band; while the 86C amplifier characteristic is more uniform in the low-frequency region.

The 300A vacuum tubes employed in the power stage of the amplifiers are highly efficient three-element tubes, with a plate-filament impedance of the order of 700 ohms. Two of these tubes in a suitable push-pull circuit are capable of closely approaching the theoretical limit of efficiency and harmonic generation for the ideal vacuum tube in Class A amplifier service—namely 50 per cent efficiency with no harmonic generation. In the 86-type amplifiers the plate-circuit efficiency of the power-stage vacuum tubes, with negative grids, is approximately 47 per cent over the frequency range where the harmonic generation is less than 1 per cent. By allowing 5 per cent harmonic generation, the efficiency of the vacuum tubes is increased to 57 per cent, and the output level to 18 watts—an increase of 20 per cent.

The use of an amplifier is frequently limited by the noise level in the output circuit—the maximum gain of high-gain amplifiers being frequently limited by the thermal noise generated in the input circuit. In addition to thermal noise, high-gain, a. c.-operated amplifiers must contend with interaction, or crosstalk, between the power and voice circuits—the fundamental or harmonic frequencies of the power circuit being picked up in the circuit elements or wiring, or generated in the vacuum tubes due to their operation on alternating current. To keep such noise at a sufficiently low value, the 262A tube, which was designed particularly for low noise level, has been employed in the preliminary stages of the 86-type amplifiers, and in addition the shield of the first-stage vacuum tube is provided with a permalloy liner.

A common source of noise in high-gain amplifiers is induction between the power and input transformers. For this reason many amplifiers are not provided with input transformers; the users of these amplifiers being required to furnish their own input transformers and to take what precautions are necessary to prevent the introduction of noise. In the 86-type amplifiers, however, input transformers are incorporated in the amplifier, and the magnetic pick-up from the power transformers is minimized by providing the input transformer with internal and external permalloy shields. These provide an attenuation of 40 db to induced noise. In this way, the equivalent attenuation between power circuit and the

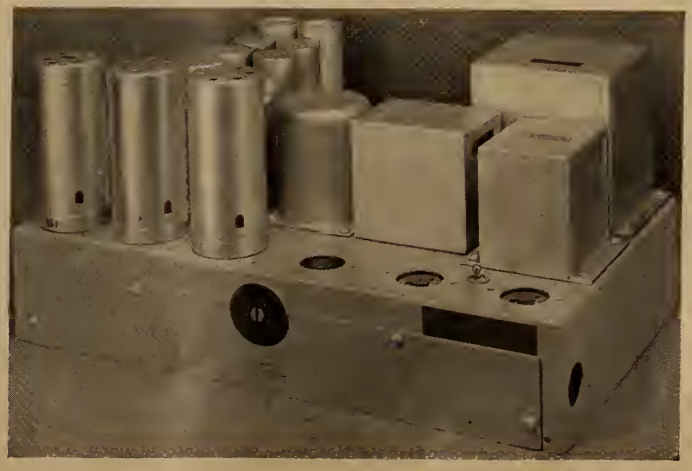


FIGURE 4

The 86-type amplifiers have a metal chassis, on the front of which is mounted the meter switch

plate circuit of the first stage is maintained at approximately 0.14 crosstalk units, or 137 db.

Construction, Installation Details

As a result of these various precautions, the noise level of the 86-type amplifiers is approximately 25 db below 6 milliwatts, unweighted, or 44 db when weighted for the audibility threshold characteristic of the ear. The volume range of the amplifiers—the range between the noise level and the overload level of 15 watts—is thus 59 db unweighted and 78 db weighted.

The 86-type amplifiers employ the familiar inverted dish type of construction, with all component apparatus mounted on the chassis in such a manner that terminals and wiring are concealed. The chassis carries the meter switch as shown in Figure 4. As used in the field, however, they are usually mounted in a perforated metal cabinet, arranged for either wall or rack mounting and measuring about 19 inches high and 10½ inches deep. When so housed, the complete assembly is known as the 1086A, B, or C amplifier.

In the particular form shown a volume control, at the lower left, is connected in the 200-ohm input circuit ahead of the amplifier, a milliameter is included for indicating plate currents, and an a. c. power switch is installed at the lower right. Beneath the amplifier and behind the instrument plate, space is provided for auxiliary filters and other apparatus which may be a part of the sound system.

Mass. Bans Doubles; Anomolous Union Situation; Some Projection Problems

THE introduction on Sept. 1 of the new standard double reel will expose to view the anomolous situation wherein the organized projectionists are opposed to the long reel nationally and receptive to it locally. Several months ago the IA *General Bulletin* announced that national headquarters was irrevocably opposed to the long reel, and it asked the support of affiliated Locals in opposing the proposed standard. Subsequently the IA Executive Board resolution condemning the double reel was unanimously adopted by the national convention.

Before and after all this activity, however, contacts made by producer representatives with local IA units resulted in approval of the new standard. So far as is known, the producers never effected direct contact with IA national headquarters, preferring to iron out threatening situations on a local basis. Whether IA local units will now go along with the producers, even in those localities where an agreement was reached, is a moot question.

In two cities, however—Boston and Cleveland—there is no doubt as to the belligerent attitude of the IA units. Advices from Boston indicate that L. U. 182's year-long battle against the double reel has been crowned with success, not only in Boston but throughout Massachusetts. Stringent regulations imposing a state-wide ban on the double reel are understood to have been approved by the Dept. of Public Safety, needing only signaturing to assume the force of law. Repeated efforts to give L. U. 182 a gentle yet positive shoving-around having failed, Boston exchanges made no preparations for the introduction of the double reel, evidently convinced of the futility of such activity.

The Cleveland situation has not been publicized as has Boston's fight, but it is no secret that the former unit will follow its own course irrespective of procedure elsewhere, even in its own State.

Chicago apparently has approved the new standard, reports indicating that the only remaining point of issue has been cleared up. Chicago authorities favored a 14″ reel, holding that the 14½″ size permitted insufficient clearance for efficient projection work. Producer headquarters report that the 14½″ reel has finally been approved.

Magazine Size Important

The Chicago incident served to emphasize an angle of the reel situation not detailed previously. The standard projector magazine is 16″; but practically all first-flight theatres have 18″ magazines, which permit ample clearance for the projectionist's fingers and also provide a clear view therein. Unquestionably the 16″ magazine is not suitable for the most efficient projection work with a 14½″ reel. Unconfirmed reports cite the availability of a 17″ magazine, ample for use with a 14½″ reel; but the 18″ magazine remains the only standard equipment available.

The producers themselves still are unconvinced that they have bought a prize package in the double-reel standard. The cost of new equipment, plus possible Union trouble, plus the necessary alterations in exchanges, plus extra work, and plus the necessity for segregating prints for those theatres whose equipment cannot handle the double reel —all this combines to make distributors jittery.

Well-informed opinion holds that theatres almost without exception will shy at utilizing exchange reels, preferring to adhere to standard practice heretofore of mounting on their own reels. The low-priced distributors' reels may fill the bill for shipping but they hardly will meet projection requirements. Of course, the new double-reel mounting will decrease projection room work in this respect, apart from the reduction in the number of change-overs.

Meanwhile, the Academy furthered its program. Sample prints exactly fitting the revised specifications were sent to each laboratory to assist in revising their leaders, so that all 2000-foot releases after Sept. 1 will carry standard leader meeting the new specifications.

Marking the 8th revision in the S. R. P. Leader since its original adoption in 1930, the specifications have been changed to include the written-out figures "six" and "nine" in the appropriate footage frames in order to assist projectionists to quickly distinguish the 6- and 9-foot leader frames, which when now viewed inverted through the projector are sometimes confused with each other. The inclusion of this additional designation will assist projectionists in more quickly threading machines between reels and will eliminate any possibility of mis-threading due to confusion of these numbers.

In addition, the wrap-around protective leader (blank protective film attached to the beginning and end of each reel) has been increased from 6 to 8 feet in place of the former 4 to 6 feet, to provide sufficient protection to the increased diameter 2000-foot reels.

Use of Exchange Reels Requires New Take-Up Pulleys

The new standard presents still another technical problem relating to take-up pulleys. The practice heretofore has been to use 2000-foot reels with 5″ hubs. using, for example, Simplex take-up pulley W-7. It will not be practical, however, to use the Exchange release reel having a 4″ hub with the take-up pulley W-7, suitable for the 5″ hub.

This pulley does not revolve fast enough to take up the first several turns on a reel equipped with a 4″ hub. Also, the 4″ hub reel should not be used in a take-up magazine equipped with, for example, Simplex take-up pulley W-6, designed for a 2″ hub reel, inasmuch as excessive pull will damage the film and likely pull it off the take-up sprocket.

The solution to this problem is a new take-up pulley which can be used interchangeably in take-up magazines for either 4″ or 5″ hub reels. A limited number of these take-up pulleys, identified as W-27, have been made available by International Projector Corp., thus disposing of this problem, the seriousness of which depends, of course, upon the extent to which projectionists utilize the Exchange reels.

The [lp] EDITORIAL PAGE

Vol. 11, No. 2 AUGUST 1936

Fire Extinguishers vs. Manpower

A Canadian province is considering revising its theatre regulations, now calling for two "journeyman" projectionists on duty at all times in theatre projection rooms, to permit the employment of one "journeyman" and one "apprentice"—provided there be installed on each projector an "automatic" fire extinguisher. Several pertinent questions stem from this proposal, the answers to which we shall essay.

Just what is an "apprentice" projectionist? If the term denotes one who is inferior in ability and experience to a "journeyman" projectionist, then the former has no place in a theatre projection room. Remember that an "apprentice" can be used only when an "automatic extinguisher" is installed, which provision in itself bares the essential nonsense of the proposal. Can the extinguisher aid in any way in maintaining a good picture on the screen?

Just what is an "automatic fire extinguisher"? We have seen many devices designed to extinguish projector film fires, but we have never seen one that supported the claims made for it. We don't believe that any such device exists. When does an "automatic" extinguisher function? Answer: *after* a fire has occurred! Does it prevent an image of a blaze from being projected on the screen? Answer: no. None of these ballyhooed projection adjuncts *prevent* fires; they merely help to *extinguish* a fire. But there *must* be a fire before they function—that's the important point. Once a film catches fire in the mechanism, it's anybody's guess as to how far it will go. When a fire occurs the projectionist instinctively acts *first* to shut off the light from the screen, after which he considers means for controlling the blaze. No "automatic" fire extinguisher is so considerate.

Projector film-fire extinguishers are either electrical, mechanical or chemical, and all of them are delicately adjusted and require care. Their installation involves extra equipment—gears or rollers, or both; added wiring, accurate placement, metal brackets, actuating arc, *etc.* So, proceeding on the theory that a projection room, installation, excluding an extinguisher, is a mass of delicately-adjusted equipment requiring constant maintenance when not working and continual attention when operating, the Canadian authorities now propose to *add more delicately-adjusted equipment* requiring additional care and more man-hours of work—with decreased (less efficient and experienced) manpower! Extra equipment is the best reason for more, not less, manpower.

When cogitating on fire extinguishers, the Canadian authorities might pause to consider this question: What is the cause of an overwhelming majority of projector film fires? The answer should come immediately: Defective equipment which is either worn or out of adjustment through inadequate or improper attention. No fire extinguisher, no matter what claims are made for it, can overcome this deficiency. Ample manpower is the only solution to this problem. Yet our Canadian friends propose adding more equipment requiring additional man-hours work in the way of maintenance and at the same time spreading the available man-hours available by actually reducing manpower! We confess to be baffled by the logic of this proposal.

Another angle of the proposed regulations interests us, and that the inclusion therein of the word "approved." Approved by whom? What mental Goliath, in terms of projection knowledge, is so well-versed in the process as to qualify for this important task? A device may work well on text and be a total loss under actual operating conditions. I. P. states flatly that there is no "approved" projector fire extinguisher—and this is the "expert" opinion of *all* ranking projection men. Now, if the Canadian authorities can dig up an "approved" extinguisher, they will be dealing in some sort of magic.

Lest we forget, also: The use of "approved" devices for "protective" work in 999 of 1,000 cases is compulsory. The political odor emanating from such setups is too pronounced to require comment herein.

One more angle. Just what relation does a fire extinguisher bear to good projection, to projectionists? Since when have the duties of a fireman become the most important element in a projectionist's work? The fire hazard inherent in projection work is only one very small item on the list of projection room routine. Theatre patrons don't consciously buy protection from fire at the box-office; they buy what they hope is entertainment. Pictures are entertaining, and the theatre management has fulfilled its admission contract, only when pictures are effectively merchandised through good projection—not fair, but good projection. *Good* projection requires ample manpower.

The Canadian authorities might give some thought to the unquestionable right of the paying patron—the same party whose tax money pays for the salaries and upkeep of regulatory bodies—to receive full value for his theatre admission money in the form of entertainment—entertainment which, in the picture business, is possible only through good projection.

Midsummer Musings on Various Topics

Random thoughts that thrust out of a sultry August day: Question—Does the signing by RCA of a contract to service 300 Fox theatres for the next five years mean that this group of theatres is lost to independent service organizations—or even projectionist service organizations—for this period? Answer—That's exactly what it means. No means has been found by I. P. for *forcing* projectionists to do this work. I. P. has done its job in this direction.

Significant indeed is the Erpi statement announcing its servicing of competitive equipments, more than half the release being given over to an explanation that this activity would in no way intrude upon the projectionist's domain. Quite different from the 1935 statements anent all-inclusive theatre servicing from the roof to the cellar. . . . . You're welcome.

Lamp manufacturers are now supplying different reflectors for 7- and 8-mm. Suprex operation. . . . Don't mention it.

A survey of five Eastern states reveals that projectionist wages average 23% under the 1929 level. The N.Y. State Assoc. of Projectionists is the only such group, so far as we know, that really functions, developments being a major interest. Incidentally, the forthcoming SMPE Convention at Rochester, N. Y., Oct. 12-15, is an opportunity seldom afforded projectionists in the upper tier of N. Y. State and Ohio. Western New England, and Canada to hear about and see first-flight technical developments. Eastman and Bausch & Lomb, among others, may be counted on to put on a good show.

THE KELLER-DORIAN, THREE-COLOR MOTION PICTURE PROCESS

Data Bearing Particularly Upon Projection Requisites of K-D Prints

By *WILLIAM E. CELESTIN*
PRESIDENT, THE KELLER-DORIAN COLORFILM COMPANY

FOR the past two years representatives of Paramount, Eastman Kodak Co. and Keller-Dorian have been at work completing the final practical tests of a new and amazingly simple three-color process. Working under actual studio conditions, the process has demonstrated its complete applicability to modern production requirements, and established a new standard of fidelity, simplicity and economy.

The Keller-Dorian process is by no means a mushroom growth. It was invented in France more than a decade and a half ago, and for the past seven years a somewhat crude version of the process has been in general use in the 16 mm. field under the trade-name "Kodacolor" ("Agfacolor" in Europe). Millions of feet of successful 16 mm. color have been made in this process by unskilled home-movie makers. Thus the task has been one of refining and adapting a commercially successful process to the requirements of present-day studio production.

This work has reached fruition in a three-color additive process which permits the use of any standard black-and-white camera with minor optical modifications and using but a single film. The processing is familiar black-and-white technique, and can be carried out in any plant; no centralized "color laboratory" is required. Experts have pronounced the screened results more true-to-life than anything yet seen; and the cost-sheets prove the process the most economical three-color system yet introduced.

In any three-color process, it is necessary to secure three color-separation images, one of which records the red components of the scene, another the blue, and the third the green. In some processes, these separations are obtained by using three separate films; in others, the three images, either as three normal-size frames or three frames of reduced dimensions, have been made on one film through intricate beam-splitters and prisms.

In the Keller-Dorian process, a unique yet essentially simple optical system combines these three separations in a frame which is to all appearances a perfectly normal single image. The celluloid base of the film is embossed to form a myriad of tiny cylindrical lenses which extend from one side of the frame to the other. A special filter consisting of parallel horizontal strips of red, blue and green is placed on the camera lens. Each of the tiny embossed lens-strips on the film forms a microscopic image of this filter on the emulsion; therefore each frame consists of an infinite number of parallel, microscopic strips, each of which is photographed through one of the primary-color filter areas of the lens.

Projection Requisites

The same principle is used in projection, with a suitable three-color filter applied to the projector's lens. Thus in photographing a red object, for example, the red rays could pass only through that part of the lens governed by the red section of the filter, and would be arrested by the blue and green sectors. This condition would be passed on to the emulsion through the lenticulations on the film-base: the red-filtered strips only would receive exposure. In the developed negative, only these red strips would be dense; the adjacent blue and green filtered strips would be clear. In the print, these latter two strips would be opaque, while the red-filtered strip would be clear.

When projecting, the light from the lamp would pass only through the clear, red-filtered section; and the embossed lens on the film would guide it to the red-filter section of the projecting-lens, reproducing the image of that part of the picture with red light. The coloring is thus produced and reproduced solely by the familiar factors of filtering and black-and-white density. Since these are so well understood from years of monochrome experience, there is no factor which can cause color-variation in the release-prints.

Any standard camera suitable for serious black-and-white cinematography can be used as a Keller-Dorian color camera. At present, the studio-type Akeley is preferred because of the advantage its 230-degree shutter offers in offsetting the light-absorption losses of the tricolor filter.

The lens used is of special design, to coordinate with the film base lenticulations. It is of the convertible type, and works at *f*/1.9. A fixed front element is used in conjunction with a variety of interchangeable rear elements, which give a wide range of focal lengths. The filter is mounted at the center of the lens, and a supplementary optical unit is installed directly before the photographing aperture to eliminate color-fringes in the out-of-focus parts of the picture.

Due to the nature of the process, the reversal process is used rather than the conventional negative-positive system. This method is well understood, and introduces no complications. Standard developing machines can be converted to reversal-processing with only minor modifications. As the film exposed in the camera is reversed into a positive,

A Note Anent K-D Projector Optical Setup

MANY a projectionist eyebrow will lift upon reading in the accompanying article of the new optical setup developed for the projection of Keller-Dorian color prints whereby an increase of 380% in illumination is reputedly obtained. Projectionists will immediately conclude—and rightly—that such a combination would be worth its weight in gold and provide the answer to many projection problems other than color reproduction.

The combination referred to in this article consisted of an *f*/1.9 lens and an *f*/2 condenser—a grand piece of optical work and a beautiful setup, indeed.

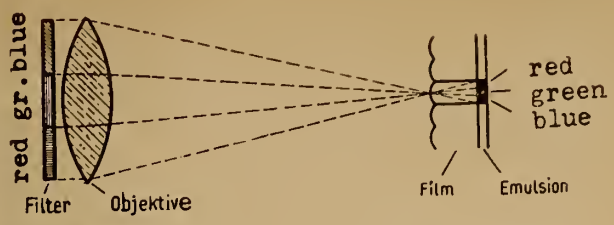
When installed in a high-intensity lamp pulling 125 amperes—the distance between the combination and the carbon crater necessarily being short—this combination literally burned up. The crater being so close, the heat was terrific and the pitting extreme. As fast as the optical people made up the combinations the projectionists broke them. What improvement, if any, has been effected is not known; but in the light of claims made for this setup this clarifying statement seems unwarranted.—*Editor.*

there is the distinct advantage of being able to screen "rushes" in full color within three hours after a scene is shot. In other words, instead of having to wait overnight, as in black-and-white, or from several days to a week, as in most color processes, after filming an important sequence to see it on the screen, a Keller-Dorian color picture can be screened in full color two or three hours after shooting it.

Release-prints are made, either optically or by contact, on lenticulated, reversal-type positive stock. The quality of the prints is entirely comparable to that of the original. Since the printing is a simple photographic operation, the results are consistent and economical.

For projection, all that is essentially necessary is the use of the three-color filter on the projection-lens. Naturally, best results will come from the use of a modern projector, with a fast lens and an efficient lamp.

As in most other color processes, satisfactory screen-illumination on the huge screens of the country's largest theatres was for a time a problem. Dr. Capstaff's recent researches, however, have solved this problem in a simple and conclusive manner. Even with black-and-white, many of these theatres lacked really adequate screen brightness, yet it was believed impossible to gain an increase in light without danger to the film, and altogether excessive amperages. Dr. Capstaff, after making useful gains by means of lightened print-densities and lighter filters, attacked the problem basically. By a combination, the exact nature of which cannot be revealed as yet, of more efficient carbons, a new and vastly improved mirror, and a speedier optical system, he increased the light-output by 380 per cent, while at the same time reducing the amperage used from an average of over 120 to 85 amperes.



Showing how the filter and embossed lenticulations on the film produce the color

Photographic Procedure

In photographing Keller-Dorian color, the same fundamental technique familiar in monochrome cinematography is used. Normal incandescent lighting units are employed, and the increase necessary for color averages from 30 per cent to 50 per cent more light than for black-and-white. How this increase is obtained depends on the technique of the individual cameraman; the majority of the Paramount cameramen simply use their normal black-and-white lighting, but with the lamps "pulled down" to a more concentrated beam.

No type of special-effects cinematography presents any insuperable problems with this process. Optical printer and matte-shot effects ean be achieved with the same facility as in monochrome. The background-projection or "transparency" process appears equally feasible, especially in view of Dr. Capstaff's recent developments in projection illumination, which should assure ample light for the use of relatively sizeable background-screens.

Color-rendition is extremely faithful; the flesh tones are especially noteworthy,

(*Continued on page* 27)

RCA To Service 300 Erpi-Equipped Theatres; Erpi's Restricted Competitive Servicing, New Reproducer

RCA dealt another stunning blow to Erpi aspirations in the sound picture field by signaturing recently (Aug. 15) a contract to service more than 300 Erpi-equipped theatres operated by National Agency Corp. (Skouras) affiliates in Western U. S. Operating subsidiaries involved are Fox West Coast, Fox Intermountain, Fox Columbia, and Wisconsin Amusement Enterprises.

The contract, extending for five years from Oct. 1 next, is the first large-scale offensive launched by RCA against Erpi on service work, the battle to date having been confined largely to theatre equipments and recording licenses. This latest RCA move follows closely the signing of major producers—notably Warner, Fox 20th-Century and Columbia—to RCA recording licenses.

Concurrent with the RCA announcement, Erpi issued a statement that it "has begun" servicing competitively-equipped theatres. This statement was viewed in informed quarters as an attempt by Erpi to draw the sting from the RCA announcement anent National Theatres by intimating that servicing of competitive equipments is something new—which it isn't on the part of either RCA or Erpi. RCA has been servicing numerous Erpi-equipped houses for almost two years, having initiated competitive-equipment servicing. At present RCA far outdistances Erpi in this respect.

The Erpi competitive-service move is seen as an absolute necessity, following the loss of 300 service contracts, as a means for keeping its service force and home office attaches busy. Still another Erpi statement announced the launching immediately of a $150,000 promotional campaign in trade papers on the new reproducing equipment, not shown publicly as yet.

Of particular interest and significance to the projectionist craft is the emphasis placed by Erpi on non-interference with theatre labor as a result of its new servicing plans—evidently an echo of the furor occasioned last year when Erpi announced its "extended servicing" of theatres from the roof to the cellar. Witness this excerpt from the Erpi statement:

"Erpi is confining its servicing activities to the sound reproducing apparatus and is in no way attempting to extend its service to take care of projection or other equipment in the booth. Nor is Erpi extending its operation to cover the maintenance of other electrical or mechanical equipment which may be located in other parts of the theatre."

As a result of signing the National Theatres service contract. RCA will immediately add 20 trained servicemen to its staff. announced F. B. Ostman. Service Manager, and will warehouse replacement parts at strategic points throughout the country for immediate availability. RCA engineers will be equipped with the most advanced test apparatus, including the cathode ray oscillograph.

That the RCA-National Theatres servicing deal is merely a forerunner to the installation of RCA reproducing equipments in most of the affected theatres appears to he a foregone conclusion.

RCA Supplants Erpi Sets in Ace Warner Houses

THIRTEEN Warner Theatres will install RCA High Fidelity reproducing equipment, ousting Erpi sets, according to advices received just as this issue of I. P. went to press. This move follows closely the Warner contract for RCA Ultra-Violet recording in Hollywood studios.

The theatre contracts were signed following trial installations at Warner ace houses—Strand, N. Y. City, and the Stanley theatres in Philadelphia and Pittsburgh. The new equipments, consisting of standard High Fidelity systems with rotary stabilizer soundheads and new, two-way cellular type speakers, will be allocated as follows: Boyd, Aldine and Germantown, in Philadelphia; Columbia and Warner theatres, in Erie, Pa.; the Yorktown, in Elkins Park, Pa.; the Washington, Pa. house; the Oritani, Hackensack, N. J., and the Smoot, Parkersburg, W. Va.

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

IN A survey conducted by Warner Bros., which piled up 725,000 answers, single-feature programs were preferred by 78% of the total. The answers submitted by proponents of single- or double-feature programs are interesting. For double-features:

1. The double-feature program lends diversity to the entertainment.
2. There is a better chance that one of the two pictures will be enjoyable.
3. It gives us more for our money.
4. We like long programs.
5. A second feature is better than shorts.
6. One feature would be too little for the admission charged. We have learned to expect a lot for our money.
7. A second feature is better than vaudeville.

Supporters of single-feature programs submitted the following reasons:

1. A good picture invariably is coupled with a poor one. We sit through the poor one to see the good one.
2. The double bill, four-hour or more show is too long for pleasure.
3. We like more shorts.
4. The pleasure of seeing a good picture is marred by the second one, which wipes out the memory of the first.
5. We dislike the manner in which pictures are billed together.
6. The long double-bill show causes eye strain, headaches and fatigue.
7. To make pictures fit double-bill programs they often are cut so much that they become jerky and lose their entertainment value.
8. If one picture is suitable for children, generally the second is not.

Allberg Heads Radio Recordists

John Allberg has been named to succeed Carl Dreher, resigned, as director of sound recording for Radio Pictures Corp., with headquarters in Hollywood. Allberg is a member of I. A. Local Union 110 of Chicago, where he was active in projection circles for many years before joining Radio on the Coast.

Newsreel Cameramen Contract

New newsreel cameramen's negotiated recently between I. A. and newsreel companies calls for a minimum of $100 weekly per man for a 40-hour week based on not more than 320 hours during an eight-week period. Unusual angle of the deal is that contract is between I. A. and employers, various local units not being a party thereto. This will enable companies to shift cameramen around practically at will, from Chicago to New York, and *vice versa*, irrespective of jurisdiction.

Contract provides for employment of "apprentices," not members of Union, up to 20% of total cameramen employed by a given company. Cameramen are protected by clause calling for payment of $10,000 in case of fatality in plane crash while carrying equipment. This figure doubles in N. Y. State where workmen's compensation law adds an additional $10,000.

2¼ Millions FHA Movie Loans

More than $2.250.000 has been borrowed by 1,300 theatres and amusement centers from private banking sources under the terms of the National Housing Act to finance repairs and modernization, according to the Federal Housing Administration. Of the theatres, 43.6% used these funds for structural alterations and repairs, while 56.4% purchased and installed machinery and equipment.

Projection was benefitted not at all by this program, inasmuch as equipment did not fall within the FHA's definition of equipment constituting "an integral part of the premises."

Atlas Corp. Buys Par. & Color Stock, Sells Loew's

Atlas Corp., New York investment house active in the picture industry, added 1,400 shares of Paramount preferred stock to its holdings during the first half of 1936, increasing its holdings of this class of Paramount stock to 5,300 shares. In the same period Atlas sold 8,000 Loew's common and acquired 9,000 Technicolor shares and an option to buy an additional 9,000. Amusement shares constitute 2.47% of the Atlas stock holdings. The company has total assets of 105 millions.

Jim Francis Named Western Division Manager for RCA



James E. Francis has been named Western Division Manager for RCA Manufacturing Co. in charge of all the company's activities in Western U. S. His headquarters will be in Hollywood, where he has been in charge of RCA operations for the past year. In addition to its studios for motion picture and phonographic disc recording, RCA maintains offices in both Hollywood and San Francisco for the sales administration of radios, tubes and parts, police, aviation and broadcasting apparatus, etc.

Mr. Francis is remembered as the sponsor of the first successful sound picture training school for projectionists, given at RCA headquarters in New York, and for his many expressions of cooperation with and friendship for the craft, among which he has many friends.

Otterson-Par. Settlement

John E. Otterson, who resigned as Erpi head to become president of Paramount, has settled his contract with the latter firm, which had four years still to run, for $200,000, according to unconfirmed reports. Otterson is not expected to rejoin Erpi.

Movie Attendance Up 35%

Busness at theatre box-offices throughout the U. S. has improved 35% within the past year, according to estimates by the Motion Picture Theatre Owners of America. Bigger and better pictures, quicker nation-wide distribution of these releases and the sameness of radio programs week after week are cited as contributory factors to improved theatre receipts. Jack Warner, production head for Warners, said that studio reports confirm a one-third attendance increase.

Dr. N. M. La Porte Dead

Dr. N. M. La Porte, for many years head of the Paramount research department, died recently at Saranac Lake, N. Y., after a long illness. La Porte entered Paramount through Balaban & Katz Theatres, in Chicago, and was active in developing Paramount's color process (the Keller-Dorian system described elsewhere in this issue). Prior to his last illness La Porte was at the Hollywood studios.

Chi. Wants 14″ Long Reel

Demands by Chicago authorities that distributors mount the new double reels on a 14″ reel, instead of 14½″, so that ample clearance will be available for projectionists failed to disturb distributors, who hold that it is not their function to supply theatres with reels for running. If the theatres prefer 14″ reels, say distributors, they are free to so mount them.

Exchanges are proceeding with plans to ship film on 14½″ reels, remounting being left to individual preference.

Some Movie Mogul Salaries

Projectionists undoubtedly will be interested in the annual incomes of those who set their salaries: Reports to the Securities Exchange Commission show that Sidney Kent, president of Fox, receives a salary of $2.500 weekly, plus $50,000 additional on Dec. 31 of each year, plus $75.000 paid to him on Nov. 1, 1935; plus $25,000 annually as presi-

dent of National Theatre Corp. (Skouras); plus $200 weekly entertainment allowance, plus an option on 60,000 shares of common at the rate of 10,000 shares annually, at $10 a share.

Darryl Zanuck, Fox production head, receives a mere $5,000 weekly, and Joseph Schenck only $2,500 weekly.

Cite Long Reels As Reason For Manpower Reduction

Trade press reports would seem to confirm the worst fears of projectionist unions that the introduction of double reels as a national standard would occasion demands for a reduction in manpower. Reports from Chicago state that Allied exhibitors are demanding a 10% cut for the coming year, on the basis that projectionists are now overpaid and that the new 2000-foot reels will ease their work considerably.

Chicago projectionists have asked for a 25% increase for next year.

KELLER-DORIAN, 3-COLOR MOTION PICTURE PROCESS

(*Continued from page* 25)

as they achieve a naturalness impossible of attainment in subtractive processes. Color experts have also remarked that the Keller-Dorian process is unique in its reproduction of true whites and true blacks. There is, too, a remarkable increase in shadow-detail when compared to most color processes. The relative brightness or softness of coloring is completely controllable; soft pastel shades may easily be had, while bright colorations are reproduced with neither unnatural effect or eye-strain.

No 'Fuzziness' or 'Bleeding'

Since the process is strictly a matter of photographic reproduction, there can be none of the "fuzziness" and color-bleeding which so often accompanies dye-image printing. The definition obtainable is on a par with the best black-and-white. In this connection, it may be mentioned that tests using normal diffusing media have shown that diffusion can be as effective in color as in monochrome.

The embossed lenticulations do not interfere with the definition, and they are not evident in the projected picture. These lenticulations are so extremely fine that even when projected on large screens they are no more visible than the perforations in the screen through which the sound passes from the loudspeakers to the auditorium. At the present time, a standard of 29 lines to the millimeter (724 per inch) is used; while if conditions should at any time warrant it, still finer embossings (up to 875 per inch) can be used without making any change in camera or projection equipment.

Recording and reproducing sound on the embossed film has presented no problem. According to the latest tests made by critical sound engineers, ground-noise due to the embossed film is practically identical with that now occurring in normal black-and-white production. Recording through the film-base on reversal film, far from being a disadvantage, has proven to be an advantage. As a direct result of the recording tests made with Keller-Dorian, the Paramount Sound Department is now

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changing over from the conventional negative-recording methods to the use of reversal-type recording stock, which is exposed from behind, through the film-base. According to the Paramount engineers, this has resulted in better sound-quality, with finer grain and a more precisely striated track.

The problem of make-up for Keller-Dorian color is extremely simple. As the rendition of color is wholly accurate, make-up does not have to be distorted to correct an unbalanced color-rendition. In the many make-up tests made, the best results followed the use of only a very light street make-up and satisfactory results were had with no make-up at all. The best test of whether a make-up for Keller-Dorian color is correct is a glance in a mirror: if an actress feels that her make-up looks natural when she inspects it in her mirror, it will be satisfactory when she sees it on the screen. A player wearing a satisfactory Keller-Dorian color make-up can wear it on the street without appearing at all "made up for the studio."

Comparative Production Costs

Since essentially standard black-and-white methods and equipment are used throughout, the item of equipment can be figured as identical with the equipment cost of black-and-white. In many instances, existing black-and-white equipment can be used; if new equipment of any type is desired, its cost will be substantially what the same unit would cost if it were to be used for black-and-white.

A production unit photographing a Keller-Dorian color picture can work exactly as efficiently as it would making the same picture in black-and-white. The extra costs for art-direction and costuming in color would be approximately the same for any color process, and depend entirely upon the individual producer's policy. All the tests made at the Paramount Studio have used standing sets from black-and-white pictures, with the actors either in street attire or in costumes used for regular black-and-white films; the results have gone far to discount the need of any extraordinary expenditures for special "color" settings and costumes.

The purely photographic costs for the process are very little higher than the cost of good black-and-white. Film, processing, "rushes" and release-prints for an average $400.000 feature produced in Keller-Dorian color should not exceed the cost of the same items for a comparable black-and-white production by more than $30.000, even under the present, semi-experimental conditions. With volume production, the costs should be appreciably lowered, ultimately reaching a point very close to, if not identical with, today's monochrome costs.

For exhibition, all that the average theatre will need will be the projecting filter. This is especially true in view of the fact that with the industry emerging from the depression, an amazing number of theatres have been modernizing their projection equipment to secure more efficient projection of black-and-white. During 1935, for instance, one equipment firm alone installed more than 1.800 new, modern equipments in theatres in this country. In most cases, these equipments will already be satisfactory for first-class projection of Keller-Dorian color. In theatres where the screen is of more than average size, the new optics devised by Dr. Capstaff, which increase the projecting light 380 per cent, can be installed for a negligible cost; and as such optics will be incorporated shortly in the newer types of projecting equipment, theatres re-equipping their projection rooms in the future will find themselves ready for Keller-Dorian color at no additional cost.

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(*Continued from page* 19)

upon the light-source used and the accuracy with which it is controlled. Color-film projection merits special attention upon the score of both quality and quantity of the projected light. In the future, the Committee's recommendations concerning projection light-sources will bear specific notations as to their applicability to black-and-white or color projection.

The Committee is particularly interested in finding a suitable light-meter that may be distributed at a price reasonable enough to induce widespread use. Several sample meters are now under consideration.

PROJECTION PRACTICE COMMITTEE

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DISCUSSION:

MR. WITTELS: Not long ago a new theatre was being built outside Minneapolis, and I gave the drawings of the projection room lay-outs to the architect, who immediately recognized their value. I believe he took the lay-out for the size of theatre he was building, incorporated in it everything that was needed, and laid out the projection room as the Projection Practice Committee recommended.

MR. KENNEDY: The Committee deserves a lot of commendation. All this discussion about light-sources and screen brightness will have to be studied from the ground up and will have to be solved. There are many

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different kinds of theatres, types of seating arrangements, sizes of screens, projection distances, and so forth, that it seems almost impossible for manufacturers to make machines that will be suitable for all conditions—that is, to provide a certain brightness of screen for any distance—while the projectors and light-sources are all made more or less according to certain standards.

As was stated in the report, there should be greater agreement among the States, which even now agree in respect to certain of the specifications. It is for this body to establish specifications and to see that the States adopt them and adhere to them. Then the manufacturers could make their equipment conform to those specifications.

MR. JONES: A great deal of the preliminary work of standardization has to be done by the technical committees. When a technical committee has reached a point at which it is ready to recommend a standard, the recommendation must go to the Standards Committee, which will then formulate the proposal in the proper manner. We are now in the course of doing that but, of course, it can not be done hastily. We must proceed in an orderly fashion.

MR. HOVER: I agree that the matter should not be taken care of too rapidly; but I happen to supervise a visual instruction program for the division of safety and hygiene of Ohio, and, to our horror, we recently found out that more than 40 high-school auditoriums had been built during the past three years, with the intention of installing sound equipment in them. The projection rooms that were provided are portable, and are 5 feet square and 7 feet high.

Other Association Contacts

MR. WILLIFORD: In the electrical manufacturing industry there is a very definite program for legislating standards. There is a Uniform Legislation Committee, and a paid staff for inspecting bills presented to the various municipal and state legislative bodies, and when advice needs to be given to those law-making bodies, it is given to them.

I am wondering whether this Society has made adequate provision for getting its standards into the proper hands and watching this legislation—particularly with respect to the American Institute of Architects. In addition to the American Standards Association, we should certainly consider taking advantage of some of these other agencies.

MR. GRIFFIN: It has been recommended that the Committee call the attention of the Association of Electrical Inspectors to the work it is doing to achieve uniform regulations throughout the country. It is a very large organization, whose members have jurisdiction over practically all the theatres of the U. S. This is an important step and certainly should result in the Committee's gaining prompt action.

MR. MITCHELL: The Non-Theatrical Committee report touches upon some of the regulations that have been promulgated and applied recently in 16-mm. projection and non-theatrical projection generally. We are making quite a point of the desirability of the Society's recognizing the conditions and striving through some sort of recommendation for uniform legislation. I think the two Committees can work together very effectively on this problem.

MR. CRABTREE: In connection with Mr. Williford's remarks, we had in mind the matter of getting together a sort of compendium of information relating to construction. About two years ago Dr. Jones and I met in conference at Rochester with representatives of the American Institute of Architects. The result was that we were requested to have some Committee or individual prepare the material and present it at one of our meetings, at which it would be discussed. After that, the idea was to present it at several of the regional meetings of the AIA, and after further discussion to publish it in their journal.

We tried to proceed with the formulation of this compendium of information. Mr. Schlanger undertook to handle the architectural side, Mr. Wolf the acoustical, and Dr. Jones the optical. I have been trying to get the three together for the past two years. Mr. Schlanger has published two papers. Mr. Wolf handed me one yesterday, and I believe Dr. Jones will speak for himself. That is where the matter stands now, but the three papers have not yet been fused together. It is a desirable thing to do, because I believe we have sufficient information at least to prevent such terrific blunders from being made as have just been mentioned.

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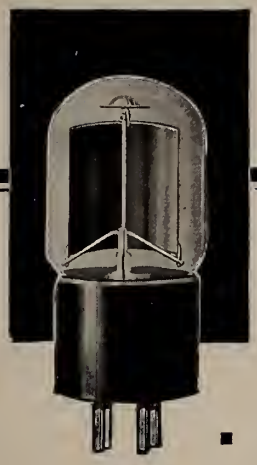
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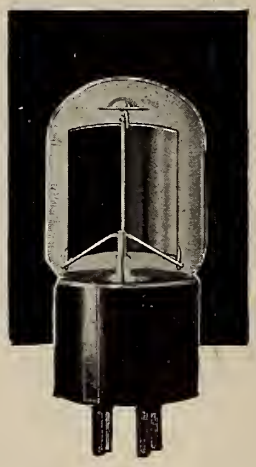
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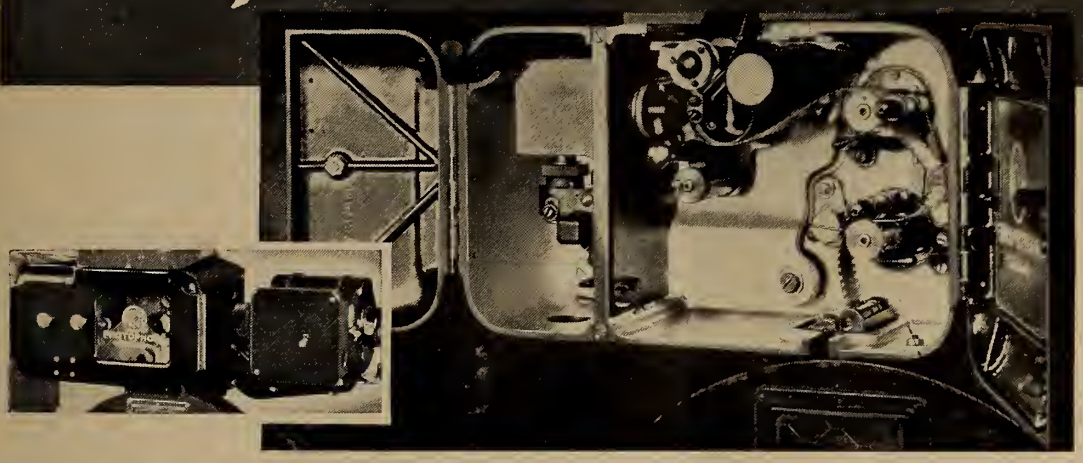
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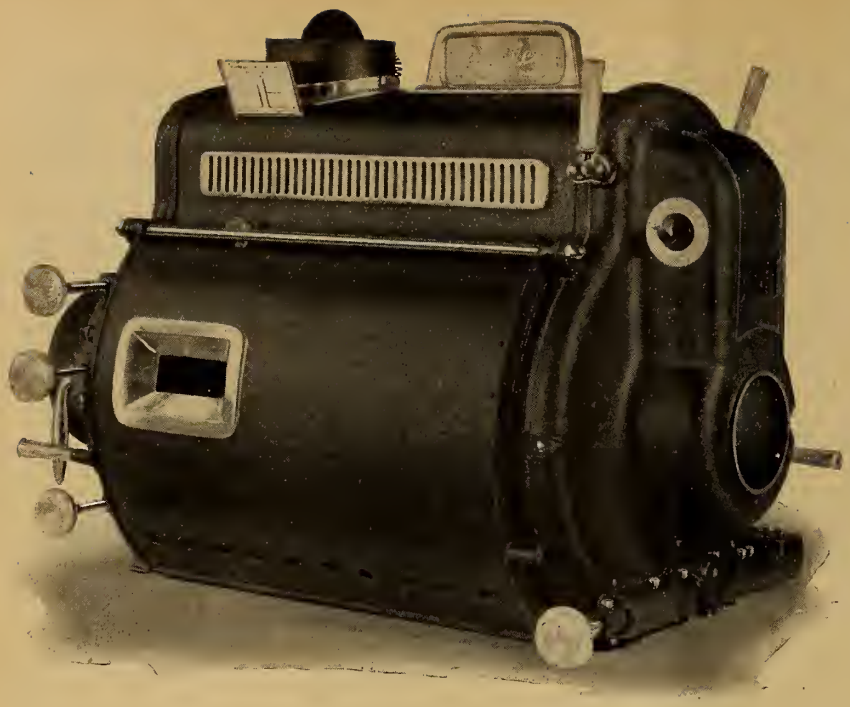
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Volume 11 SEPTEMBER 1936 *Number 3*

Index and Monthly Chat..... 5

Maintenance Problems of the High-Intensity Arc, II..... 7
A. C. SCHROEDER

The New W. E. "Mirrorphonic" Sound-Picture Equipment... 11
JAMES J. FINN

Definite Trend Toward High-Intensity Arcs in Theatres and Studios 15
W. C. KALB

Technical and Economic Aspects of Copper-Oxide Rectifiers... 17
C. E. HAMANN

Reel Length a Minor Projection Problem; Print Density, Sound Level Acute..... 19
THAD C. BARROWS

An Inquiry Into the Kneisley Low-Intensity Lamp Conversion Process..... 20
R. F. KNEISLEY
I.P. STAFF WRITER

The Editorial Page..... 23

News of the Month..... 24

Industrial Unionism in the Theatrical Field 27
JAMES J. FINN

Projection Problems Feature S.M.P.E. Meet Program..... 28

News Notes
Technical Hints
Miscellaneous Items

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MONTHLY CHAT

RECENT issues of I. P. have been more general in scope and more useful to the practical projectionist, writes a subscriber from Miami. The reason for this is simple: the projection field is once more astir with developments relative to new equipments, the inevitable attempts to so modify old equipments so as to match the new, and improvement in operating technique.

THIS issue is representative of the job I. P. is trying to do for the craft: it includes a description of a new sound system, an article on the trend in carbon-arc lighting, an inquiry into a currently popular conversion process, a service story, more data on copper-oxide rectifiers, information on h.i.-arc maintenance—and much more. Now if the response from the craft would only perk up a bit—well, I. P. would really *be* something.

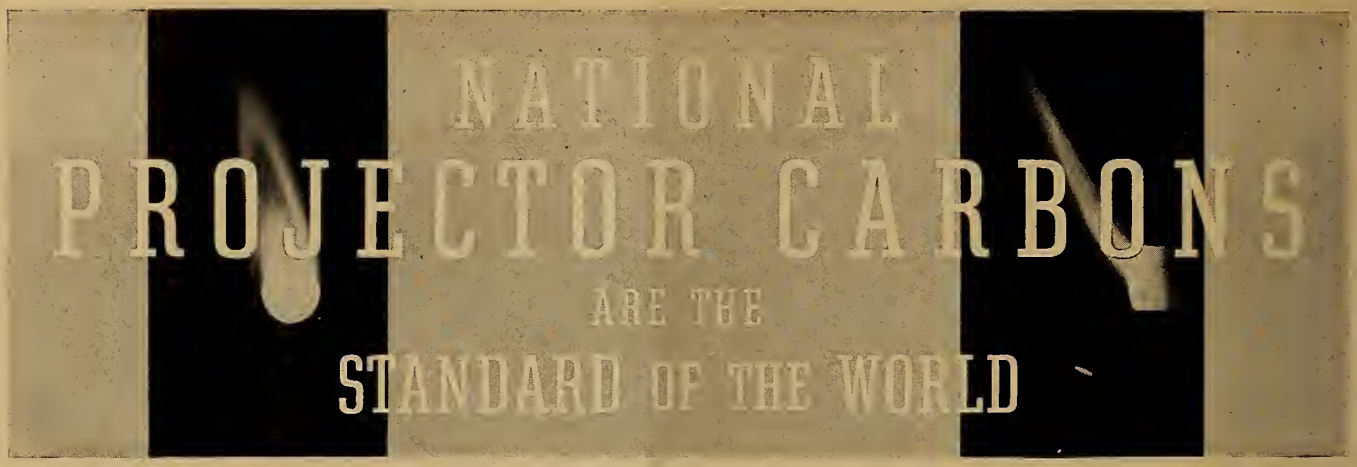
COLOR chemical affected the sound track on a recent feature released nationally, necessitating its recall. If some bright boy hadn't stumbled over this one, some other bright boy would have ascribed the poor reproduction of this feature to projectionist shortcomings. Before taking any nonsense in the form of managerial complaints anent poor reproduction, Mr. Projectionist should check both the print and his equipment in order to know just where he stands.

MORE than a year ago we counselled lamp manufacturers not to strenuously oppose conversion jobs, our slant being that, once the field became accustomed to the Suprex white light and more of it, the conversion jobs of 1935 would inevitably result in the installation of new lamps in 1936. Our prediction has been borne out—which shows how thoroughly discredited are conversion jobs.

SQUAWKS about release print density and sound levels are on the increase. The switch to double reels can hardly be expected to overcome these deficiencies, as Thad Barrows points out elsewhere herein. Here's a project lying right in the Academy's backyard.

LAMP manufacturers report a continuing demand for low-intensity and a.c., high-intensity lamps. The answer to which is beyond this corner.

OUR editorial methods are concisely described by one manufacturer as "muck-raking"—referring, of course, to the open discussions appearing in these pages. We regret the existence of such an opinion about us; but our readers just dote on the discussions referred to. Although very much in the dark as to where this leaves us, we derive some consolation from the generally recognized fact that we *do* have an editorial policy.



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		Negative	.....		7 mm x 8″
21-25	54-57	Positive	12 mm x 8″		.....
		Negative	8 mm x 8″	or	8 mm x 8″
26-30	54-57	Positive	13 mm x 8″		.....
		Negative	9 mm x 8″		.....
31-35	54-57	Positive	14 mm x 8″		.....
		Negative	10 mm x 8″		.....
			National SRA Cored Projector		
28-32	54-57	Positive	12 mm x 8″		
		Negative	8 mm x 8″		
32-42	54-57	Positive	13 mm x 8″		
		Negative	8 mm x 8″		



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INTERNATIONAL PROJECTIONIST

VOLUME XI NUMBER 3

SEPTEMBER 1936

MAINTENANCE PROBLEMS OF THE HIGH-INTENSITY ARC

By *A. C. SCHROEDER*

MEMBER, PROJECTIONIST LOCAL UNION 150, LOS ANGELES, CALIFORNIA

II

CONTACT shoes that carry current to the positive carbon should be cleaned daily. Formerly, the practice was to clean these by wrapping a piece of emery cloth around a negative carbon and then work it back and forth in the shoe. This is a bad practice, the prevalency of which I do not know, but it is no longer followed in this section (West Coast). It is bad for two reasons: the opening in the shoe becomes "bell-mouthed," that is, the "hole" becomes larger at the ends than it is in the center; also, the entire "hole" becomes larger in diameter, and then the shoe touches the carbon at only one point.

Actually the contact is not reduced down to a point but still to a considerable degree, causing the shoe to burn even more than it would normally. The current-carrying capacity depends upon the area through which the current flows, and when this is reduced, the heating effect becomes greater. Since there is already too much heat, every possible means must be employed to maintain a large contact.

This is easily accomplished by cleaning the shoes with a large wire brush. The brush may be sawed into pieces of the proper size so that the wires get down into the groove. At our workshop we use a brush made of brass wire, originally intended to clean suede shoes, which is sawed in half and is just the stuff. It removes the dirt but does not change the shape of the groove.

The adjustment of the shoes is very important. If they are too loose, they burn; if they are too tight, they wear the driving mechanism more than is necessary and the carbon may not rotate or feed. It must be ascertained first if the shoes come together properly and easily, so that nothing interferes with their movement toward and away from the carbon. This is important, being a frequent cause of trouble. If X in Fig. 3 touches the corresponding part on the opposite shoe, when the carbon is in place the shoes will not make proper contact on the carbon. Usually it is possible to see how close these points come in most lamps. There should be a fair amount of clearance when the shoes are against the carbon.



FIGURE 3

Some method of keeping the shoes in position, such as that shown in Fig. 4, is provided in the different makes of lamps. The small plate to which the arrow points fits into a slot in the shoes. This piece becomes blistered, or covered with small projections, caused by current flowing from the shoes to this plate and then to the positive terminal. These small projections bind in the slot in the shoe, thus causing the latter to become more or less anchored in one position so that it will not contact the carbon properly. Of course, the current is not

supposed to go from the shoe to this plate, and only does so because the resistance between the shoe and the positive lead through the normal path is greater than it should be.

New flexible connecions may help, or some of the other contacts in this circuit may be loose or corroded. It is hardly possible to completely stop the flow of current through this small plate: some of it will always take this path. To overcome this we have recently replaced these plates with others made of transite. Results thus far have been great; but the plates have not been in use long enough to indicate whether the transite will stand up.

The final check as to how the shoes will close in on the carbon is to withdraw the carbon and see if the shoes close up. There should be an appreciable movement toward each other. If this test is made with a rather weak tension on the spring, we can be certain that the brushes are free to move as they should. Then when the tension is increased to the proper point, we are doubly sure.

Proper Tension Important

Now, how are we to judge the proper tension? Release the feed rollers, so that the carbon is free at this point. In some lamps this is positive and there will be no doubt as to the rollers being free of the carbon. In others it is best to open the release lever, and then keep pressing on the lever while the manual feed for the positive carbon is turned in a backward direction, as though the carbon were drawn toward the back of the lamp. This tends to force the feed rollers apart, and they will stay that way, entirely free of the carbon.

When the positive carbon is gripped by a sort of a collect chuck, as it is in one type of lamp, there will be no trouble on this score. On this particular lamp the contact shoes can also have a greater tension, as far as still being able to keep the carbon rotating and feeding forward, but this will occasion unnecessary strain and wear on the driving mechanism.

After the carbon has been released from the feeding device it is easy to move the carbon forward and backward by hand and to feel how much drag the shoes are exerting. There should be an appreciable drag, but not such as requires a great effort to move it.

With the proper tension on the shoes, we can then adjust the tension on the feed rollers. Personally, I like to get them just tight enough to feed and then give the adjustment another turn. Another method is to tighten the tension on the *shoes* one turn more than is desirable, then adjust the tension on the feed rollers, after which the tension on the shoes is again reduced by one turn.

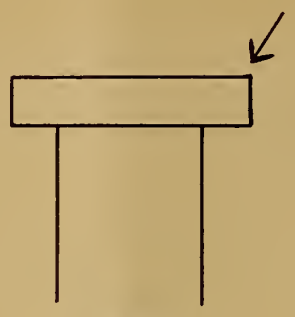


FIGURE 4

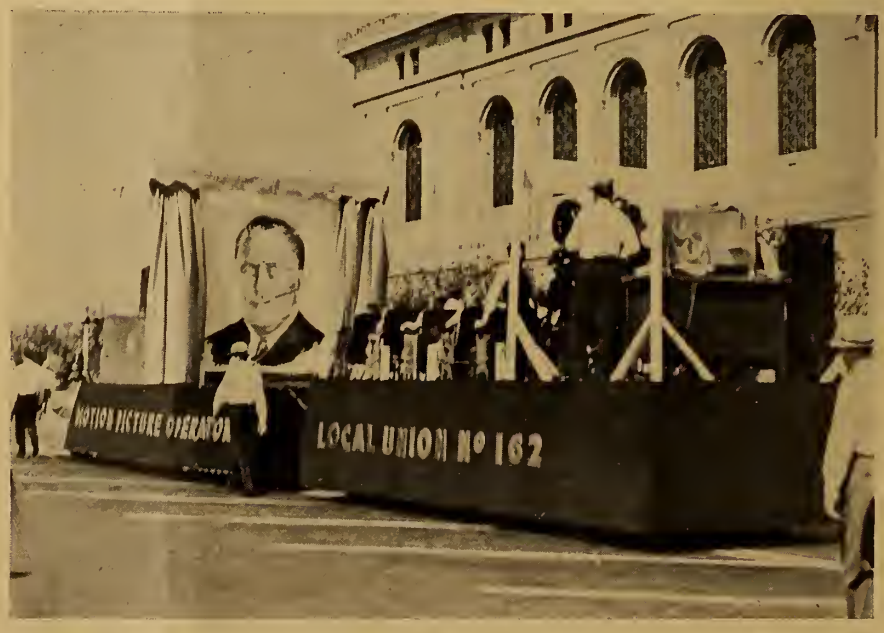
When the mechanism is such that the feed rollers tend to be forced away from the carbon when the feed is turned backward, it is a good plan to adjust the tension until it is just tight enough to pull the carbon back. Due to the tendency of the scroll to force the feed rollers against the carbon when they are turned in the normal direction, the adjustment will now be sufficiently tight.

Adjustment of the speed of the feed in the various lamps is usually self-evident. Inspection will reveal the method to pursue. If it is impossible to speed up the feed enough to take care of normal burning of the carbons, it will often be found that some part of the mechanism is binding, or the tension on the shoes is too great, or the hole in the baffle insert has caked up to such an extent that it is too small for the carbon—provided that the feed motor and its gearing are alright. We have had some trouble with crooked carbons: on a new trim the end of the carbon would rub against the hole in the rear of the lamp with enough pressure to keep it from rotating and, consequently, feeding.

In the last six or eight months the carbons have been coming through a great deal oversize. This caused us much trouble until we reamed out the hole in the rotating spindle. This refers only to 16 mm. carbons; I don't know whether 13.6 mm. carbons have been giving the same trouble. If it should become necessary to ream the spindle in your lamps, you will have to get an expansion reamer. Take small cuts, and put it through a number of times. It is unwise to take out very much at a time. Before starting, be sure that the feed rollers have been backed away, also the contact shoes; also, it would be a good plan to remove the baffle insert, although I doubt if it would be close enough to the reamer to get in the way. If the reamer should hit any of these elements, the edge will be taken off, and the probability is that it will chip the blade. These reamers are quite expensive, thus extremely careful handling is imperative.

Baffles and baffle inserts can cause much trouble. A local shop (Los Angeles) made some replacement parts several years ago. The baffles were of "exceptional" quality, being made of monel. It happened that we were the first to use these new baffles. Just about that time our arc became uncontrollable, but for a long time we failed to see the connection. It finally dawned on us that it was the magnetic material in the baffles that was causing the trouble. When the old non-magnetic baffles were replaced, the arc settled down and acted as any good arc should.

As mentioned previously, a little common sense will go a long way to solve any troubles with this type of lamp.



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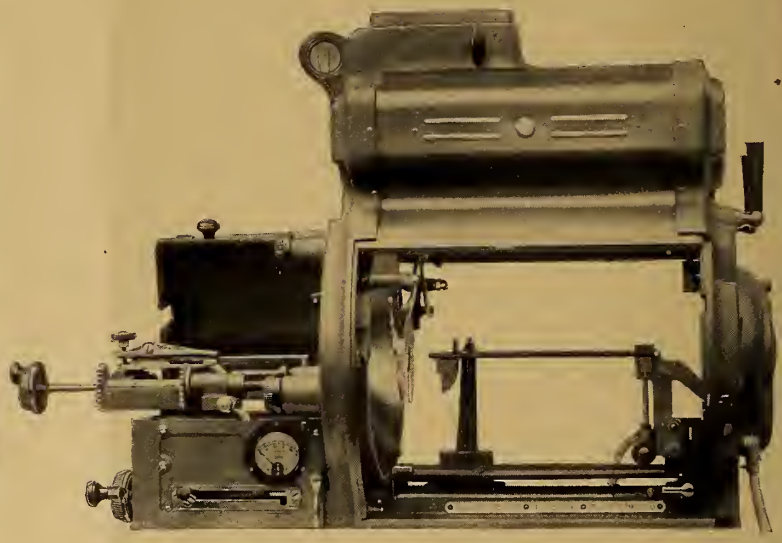
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THE NEW W. E. 'MIRRORPHONIC' SOUND-PICTURE EQUIPMENT

By *JAMES J. FINN*

FOREWORD: The latest development in the sound picture field is the Erpi Mirrorphonic reproducing system. The introduction of this equipment was marked by widespread publicity of a general nature in the trade press and elsewhere; but it remained for I. P., as usual, to present the first complete technical description —the what, why and how—of this system. Several units of the Mirrorphonic system have already been described in these pages: the celluar loudspeaker[1], which constitute probably the most important feature of the system; the 86-type amplifier[2], the 300A vacuum tube[3], and the 262A tube[4].

Space limitations prevent presentation of detailed information anent all Mirrorphonic components in this issue: held over until next month is the description of the 87- and 91-type amplifiers, the so-called "Harmonic Suppressor," a unit which permits the delivery of maximum volume without distortion, and various control and testing auxiliaries. With the publication of this second article, I. P. will have covered completely all units of this new system.

This presentation is profusely illustrated, views of the more important units being given in both halftone and line drawings, as in the case of showing the radically different paths of film travel through the sound heads. In fact, the pictures themselves tell practically the whole story, providing a direct comparison between this new system and the earlier Erpi installations—a point in which projectionists are particularly interested.

Projectionists are naturally interested in the procedure necessary to obtain for their theatres results matching those of a complete Mirrorphonic installation. This situation is discussed in an appendage to this article, which should have the close attention of projectionists so that they may competently advise managers and owners relative to modernization of existing equipments. This development, no less than visual projection equipment, will, or should if projectionists are on their toes, receive its greatest impetus from the projection room.

Apart from compilation and manner of presentation, no pretense of originality is made for this article, included in which are liberal excerpts from material prepared by Bell Telephone Laboratories and by Erpi. Inquiries from the field relative to any feature of this equipment are invited.—*Editor.*

PROJECTIONIST interest in any new equipment development, whether for visual or sound reproduction, is centered upon the difference between the new and the old with respect to design and construction, operation and results obtained. This article is an attempt to answer the question, "What is the Mirrophonic system?" in such a manner as will best provide a direct comparison between this new equipment and earlier Erpi installations.

Well, what is the Mirrorphonic system of sound reproduction? Briefly stated, and in advance of detailed information relative to its components, the Mirrorphonic system provides better sound reproduction by means of: (1) new sound heads, employing a "kinetic scanner," which constitute a radical departure from earlier Erpi designs; (2) new amplifiers—the 86-, 87- and 91-type jobs—which, with the aid of a "harmonic suppressor," deliver much more power than previous Erpi amplifiers, and (3) the comparatively new cellular speakers which assure uniform distribution of sound throughout the entire theatre seating area through a blending of high and low frequencies.

Overall, the equipment is much more compact and the various units (reproducer set, main amplifier and speakers) more nearly self-contained than previous systems, making for less difficult and more rapid checking and adjustment. Although handling greatly increased power, the system's design permits greater efficiency and more economical operation. Special aids for the projectionist are included in the system: (1) the independent monitoring system; (2) the vacuum tube test meter, and (3) the speaker test set—all of which will be described next month. The Mirrorphonic system is credited by Erpi as capable of encompassing a frequency range of from 40 to 10,000 cycles. The equipment is entirely operated from a 105-125 volt, 50- or 60-cycle power supply, all batteries having been eliminated.

There are five Mirrorphonic unit-combinations, from M-1 to M-5, the type of equipment installed depending upon the conditions that have to be met in a given theatre. Table A shows the various unit-combinations which apply in general to various types of theatres, any deviations from which schedule shall be dictated either by customer preference or unusual acoustical considerations.

The "Standard" Soundhead

With the Mirrorphonic system Erpi introduces two new soundheads—"Standard" and "Heavy Duty"—which differ radically from earlier Erpi designs. It is estimated that two-thirds of the 17,000 theatres in the U. S. equipped for sound-picture reproduction have less than 600 seats, thus the Standard sound head which is used exclusively for this size theatre (see Table A) is of primary importance and interest. Fig. 1 is a line drawing of the Standard sound head, showing the path of film travel; Fig. 2 is a halftone of the same head.

Figure 1 discloses several unique

TABLE A: Mirrorphonic Unit-Combinations for Various Types of Theatres

System	Capacity	Amplifiers	Speakers	Sound Head	Horn Panel	Monitor Ampl.
M-1	over 3000 seats	86 & 2-87 100 Watts	2-594 4 cones	Stand. or Heavy Duty	Yes	Yes
M-2	up to 3000 seats	86 & 87 50 Watts	2-594 4 cones	Stand. or Heavy Duty	Yes	Yes
M-3	up to 1500 seats	86 15 Watts	1-594 2 cones	Stand. or Heavy Duty	No	Yes
M-4	up to 1500 seats	86 15 Watts	2-555 2 cones	Stand. or Heavy Duty	Yes	Yes
M-5	up to 800 seats	91 8 Watts	1-555 1 cone	Standard	No	Yes

[1] I. P., *March*, 1936, p. 19.
[2] I. P., *August*, 1936, p. 20.
[3] I. P., *July*, 1936, p. 20.
[4] I. P., *February*, 1933, p. 21.

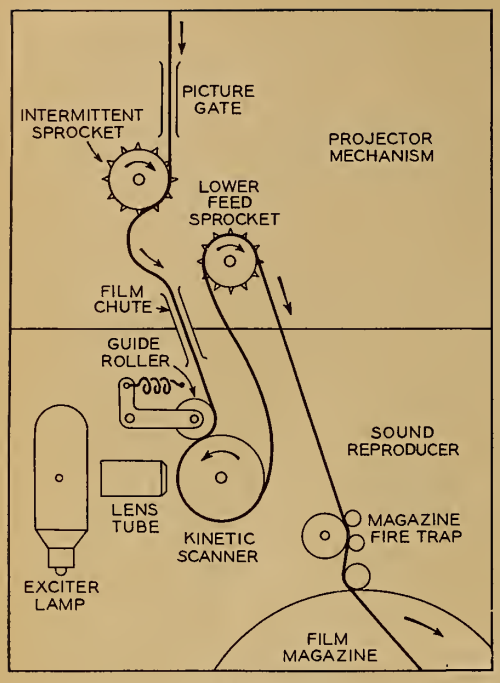


FIGURE 1

Showing path of film travel in Standard soundhead. The film passes from the intermittent sprocket around the drum (kinetic scanner) and then over the projector lower feed sprocket (see Fig. 2)

soundhead features: the path of film travel, the "Kinetic scanner," the absence of gears or sprockets, and the adjoining parallel strips of film running from the film chute down to and around the scanner and on up to the projector lower feed sprocket—which features demand close inspection.

The most important element herein is the kinetic scanner, it being a fundamental requisite for good sound reproduction that the film pass the scanning point at a uniform speed. Many projectionists are familiar with rotating-drum film-scanners, of course, but the details anent the application of the principle in this instance are of interest. The kinetic scanner is used in both the Standard and Heavy Duty soundheads.

Erpi's kinetic scanner is an inertia-controlled scanning drum which is mounted on precision ball bearings to reduce friction to a minimum. Extra precautions have been taken to effectively seal the ball bearings against the entrance of dust, since this would interfere with the smooth rotation of the scanning drum and introduce disturbances in the reproduced sound. The initial lubrication should last for an indefinite period. Constant speed of the scanning drum is maintained by means of the specially designed double flywheel: one flywheel is integral with the scanning drum which effectively prevents high-frequency oscillations of the film; the other is free floating and is coupled to the first one by means of a mechanical filter which effectively suppresses slow oscillations.

The kinetic scanner is so stabilized that a sudden change in film speed or a disturbance in the film loop, such as the passage of a film splice, has no appreciable effect on its uniformity of rotation. During the acceleration period of the scanning drum the two flywheels are coupled together by means of a centrifugal clutch.

The film is guided by a pivoted guide roller onto the drum of the kinetic scanner around which it is wrapped (Fig. 1). The extremely low friction of the kinetic scanner allows the film to rotate it without being subjected to appreciable tension, resulting in the formation of an elastic film loop between the scanning drum and the feed sprocket which introduces a compliance between sprocket and drum and prevents the sprocket tooth impulses from being transmitted to the scanning point.

The film chute can be readily dismantled for cleaning. Film scratching and abuse is eliminated by the use of highly-polished film guides. The pivoted guide roller, supported between bronze bearings lubricated through covered oil cups, is provided with chromium-plated flanges to resist wear and positions the center of the sound track at the center of the optical system. Its adjustment is accomplished by a slotted knob which is accessible through an opening in the closed door. It is thus seen that no film sprocket or sprocket drive mechanisms are employed in the sound reproducer, as has been the practice heretofore. This results in a much less expensive and simpler construction. The location of the lower film magazine is such that the usual projection angles are readily attained.

The writer was particularly interested in two features of this head: (1) the increased amount of film therein, and (2) the possibility of flutter occasioned by the rather long adjoining parallel film strips (Fig. 1). Erpi has given assurances that the design of this head not only does not induce more flutter than earlier heads but actually effects a sharp reduction thereof. Erpi offered to confirm these assurances by a practical demonstration, an invitation which will be accepted by the writer at an early date and reported upon subsequently. The answer as to whether there is too much free-running film in this head will be forthcoming after the design is used under practical operating conditions. Incidentally, all Mirrorphonic unit-combinations, from M-1 to M-5, meet the requirements of the National Board of Fire Underwriters.

The exciter lamp is mounted in a separate holder external to the sound reproducer. To eliminate adjustments and to facilitate replacement, a new

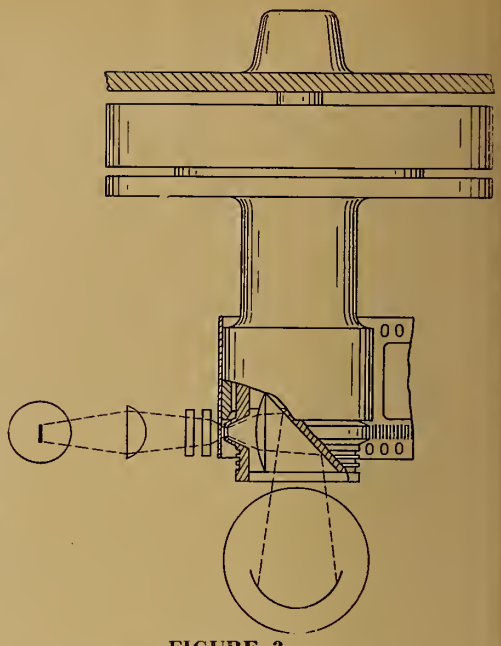


FIGURE 3

A total reflecting prism is located within the scanning drum to deflect the light which has passed through the sound track out at right angles into the photo-electric cell

type of lamp provided with a pre-focus skirt on its base is employed. This permits the use of a low-cost automobile-type of pre-focus socket, obtainable from any commercial dealer.

The lens tube assembly, hermatically sealed, differs from earlier designs in that it images the incandescent filament of the exciter lamp as a concentrated line of light directly on the sound track of the film by means of cylindrical lenses *without the use of a mechanical slit.* The assembly may be adjusted with the com-

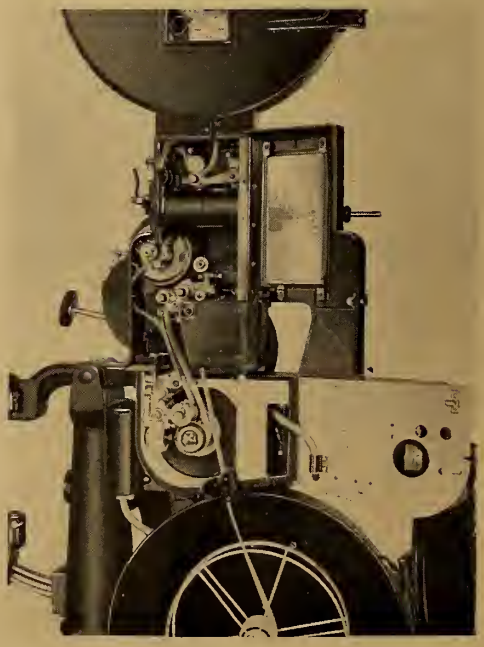


FIGURE 2

Halftone presentation of the Standard soundhead (see Fig. 1)

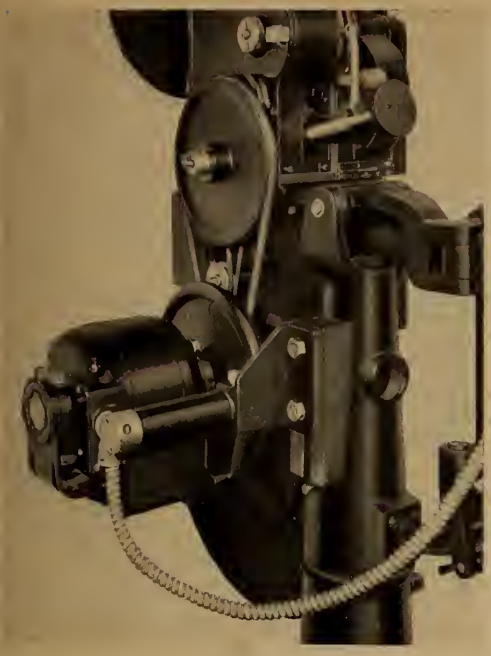


FIGURE 4

The projector mechanism is driven by a round endless belt. A 1/6 HP induction motor, pivoted so that its weight keeps the belt taut, is the source of power

partment door closed by removing a latch plate. This exposes an opening through which the focus adjustment at the back of the lens tube may be made and also a screw and lock nut for adjusting the light beam azimuth.

A total reflecting prism with one convex surface, shown in Fig. 3, is located within the scanning drum to deflect and focus the light rays, which have passed through the sound track of the film, out at right angles into the photoelectric cell. The prism is mounted in a holder which can be removed readily for inspection and cleaning without disturbing its adjustment. The prism holder incorporates an aperture which is introduced immediately behind the film-scanning point to limit the length of the effective scanning line and to prevent stray light from entering and affecting the sound reproduction.

The new-type photoelectric cell has a higher gas amplification factor than was formerly obtainable. This cell and associated transformer, cushion-suspended to reduce microphonic disturbances to a minimum, and a condenser are mounted on the door of the film compartment. This method of mounting does not appeal particularly to the writer, for obvious reasons; but it may work out. The entire assembly is protected by a sheet metal cover, which also acts as a shield againt external electrical disturbances. When the door is opened a clear path is presented for threading the film and easy accessibility of the parts. A flexible armored cable brings the p.e. cell circuit from the door to the terminal compartment at the front end of the head.

The projector mechanism is driven by means of a round endless belt (Fig. 4). A 1/6 horsepower induction motor drives the projector and is mounted upon a pivoted bracket secured to the pedestal so that its weight supplies the necessary tension to the driving belt. The bracket is provided with means for adjusting and maintaining sufficient belt tension.

The driven pulley is equipped with a gear which meshes with the projector gearing. This pulley and gear rotate on a stationary shaft supported from the projector. Lubrication is provided through an oil cup conveniently located. A combination flywheel and handwheel is attached to the driving motor to prevent too rapid starting of the projector mechanism, which might result in film damage, and to facilitate turning the machine over by hand during the film-threading operation. The take-up drive of the lower film magazine is connected by a belt directly to the projector mechanism in the conventional manner.

Belts as a means for driving sound-picture projectors are not favored by the writer, whose personal preference is a chain drive. However, the utilization

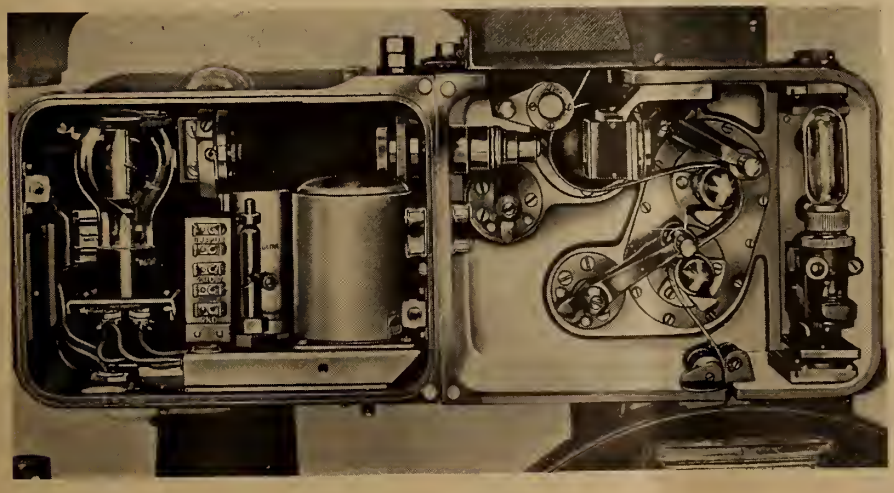


FIGURE 6

Halftone presentation of Heavy Duty soundhead (see Fig. 5)

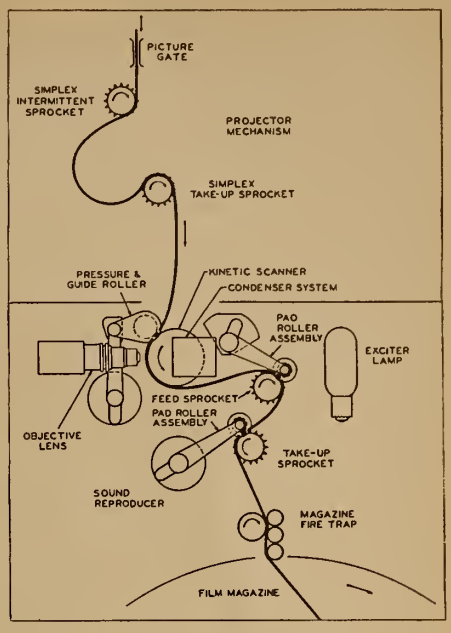


FIGURE 5

Showing path of film travel in Heavy Duty soundhead. Compare with Standard head (Fig. 1) on threading, sprockets and scanning system (see Fig. 6)

by Erpi of an adjustable pivoted-bracket mounting for the drive on this equipment serves to lessen somewhat the opposition of the writer to this form of drive. Fairness demands the statement that during the rather extended inspection of the equipment made by the writer there was no evidence of belt slippage.

The "Heavy Duty" Soundhead

The "Heavy Duty" Soundhead, designed to meet "certain specialized operating problems imposed . . . by unusual theatre conditions," is shown in Figs. 5 (line drawing) and 6 (halftone). The superiority of this head over the Standard soundhead is apparent at a glance. The former utilizes both feed and take-up sprockets, it does not reflect a straining after economies in manufacturing or operation, it employs the kinetic scanner, and its path of film travel follows the more conventional pattern dictated by advances in the art.

Close inspection of Figs. 5 and 6 will convey clearly the method of threading and the path of film travel, making superfluous any further comment herein relative to this aspect of the equipment.

A radical departure from conventional sound-track scanning methods is made by this Heavy Duty soundhead. This lineup, termed by Erpi the "Optical Bridge," completely reverses the usual scanning order (followed in the Standard soundhead, Figs. 1 and 2) in that the light beam is transmitted through the film from the celluloid side (back) to the emulsion side (front). Fig. 7 shows this novel scanning method in detail. Through the employment of a

high-grade microscope the minute sound track pattern is greatly magnified and projected through a large masking slit approximately 1 inch long and .00012 inch wide and into the photoelectric cell. Both the slit and the cell are enclosed in a compartment which Erpi asserts is dust-and-oil-free. It is apparent that this arrangement constitutes a rather long light path, its principal function apparently being to effect a reduction in ground noise. This head is adaptable to push-pull reproduction.

The worth of this unusual film-scanning method cannot be evaluated by the writer at this time, only one experiment therewith having come to his attention, the results of which are unknown. Reports from the field relative to the practical application of this method to sound-picture projection will undoubtedly be received, however, and will be published in these columns.

A self-aligning, grooved mounting plate couples the projector mechanism to the soundhead. Projector head replacements can be made in less than twenty minutes. Provisions are made for mounting with Simplex, Super-Simplex, Surefit, Motiograph and Powers projector Mechanisms.

Both a. c. and d. c. motors start the sound and projector mechanisms gently and provide uniform vibrationless power. They are equipped with sealed ball bearings and may be interchanged in less than fifteen minutes. A self-contained oil supply provides complete automatic lubrication.

I. P. readers are already familiar with the development of the cellular type loudspeaker,[1] thus this exposition of the Mirrorphonic "Di-Phonic" speaker equipment (Fig. 8) will be limited to a review of the technical reasons which dictate the use of such speakers in any high-quality sound reproducing system.

The Mirrorphonic speaker system departs from previous sound system design in both its electro-acoustic characteristics and physical appearance—yet it retains a time-proved feature: the principle of "exponential" horn taper. Exponential taper has been both practically and theoretically demonstrated to be the most effective horn design for radiating a "flat" or uniform field of acoustic energy from a vibrating diaphragm.

The ordinary loud-speaker (either the horn or baffle type) becomes directional in its characteristics at the higher frequencies. Low-frequency sounds spread in all directions from the mouth of the horn; but the higher frequencies tend to concentrate into a beam which is projected directly ahead of the horn. The width of this beam becomes narrower and narrower as the frequency increases. Because of this fact, the audience never hears quite the proper blending of sound frequencies. Those patrons directly in front of the horn receive too great a proportion of the high frequencies; while those on the sides receive too much of the low frequencies. In addition to this separating effect, it has been found impractical to design a single loudspeaker with sufficient performance latitude to effectively respond to both extremely high and extremely low sound frequencies.

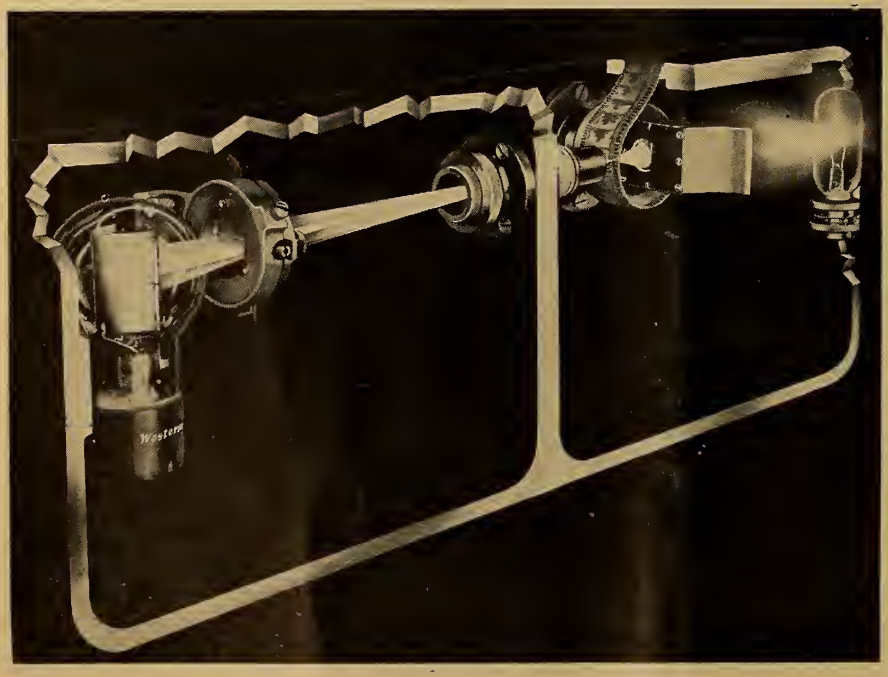


FIGURE 7

Film-scanning system of the Erpi Heavy Duty soundhead which reverses the usual order. Light beam is transmitted from the celluloid side (back) to the emulsion side (front) of the film



FIGURE 8

Di-Phonic speaker system, comprising one cellular h.f. unit and two l.f. units with baffle. Overall depth 48". Speaker network in box for amplifier rack mounting

The Mirrorphonic (Di-Phonic) system employs two separate "cellular" type radiators or "elements." One element, somewhat resembling a "baffle," is used for the frequencies from about 35 to 300 cycles; and another type, which has the outlines of a horn, is used for the range above 300 cycles. The new equipment is capable of yielding a power range of 100,000,000 to 1, and therefore can handle the entire volume range of a symphony orchestra.

When speaking of the "range of loudness" which can be handled by an electrical system of reproduction, one is concerned with the differences between the loudest and faintest sounds which it can reproduce. There is, in addition, the problem of handling the peaks of maximum loudness. These peaks, in the case of music from a symphony orchestra, are beyond the possibilities of the ordinary loudspeaker to reproduce without distortion. Low-frequency sounds make the largest contribution to the peaks of sound power which must be handled to meet these conditions. The diaphragms of the Mirrorphonic low-frequency element are nearly 20 inches wide, and as many as four of these driving units are coupled to the low-frequency element.

Both the high-frequency, or "multicellular" element, and the low-frequency element, which resembles a dish-type baffle, are divided into individual cells. Each cell of the high-frequency element is developed in accordance with the exponential taper principle; and although the low frequencies are less difficult to evenly radiate, a special taper development is applied to this element also.

A special "network" of the low-loss

(*Continued on page* 29)

DEFINITE TREND TOWARD H.-I. ARCS IN THEATRES AND STUDIOS

By *W. C. KALB*

ENGINEERING DEPARTMENT, NATIONAL CARBON COMPANY

Distinct improvement in the carbon arc light source has resulted in a higher quality of motion picture lighting. The present trend toward a more extensive use of the h.-i. arc is pronounced, no less in studios than in theatres—a development of prime interest to projectionists because of the interdependence of both branches for overall best results. The appended paper, presented before the S.M.P.E., draws some interesting comparisons between the various carbon arc light sources.—*Editor.*

THE necessity for using, in projection, a light-source of very high intrinsic brilliancy is illustrated by the following example: A screen image 20 feet wide is 90,000 times the area of the 0.800-inch aperture through which the light is projected, and with a magnification of 6:1 from the crater to the aperture, is 3,240,000 times the area of that portion of the light-source focused within the aperture limits.

Disregarding all losses in pick-up and transmission, an intensity of 10-foot candles incident upon the screen calls for a brightness of 111 candles/mm. at the source. A 120-degree mirror picks up only about 75 per cent of the total light emitted by the source. Losses through the film and the lens further reduce the intensity of illumination of the screen. It is therefore obvious that screen sizes now in use have gone well beyond the limit at which the low-intensity arc with a maximum intrinsic brilliancy of 175 candles/mm. can provide a satisfactory level of screen illumination.

Low-Intensity Arcs.—There is a definite limit to both the intrinsic brilliancy and to the whiteness of the light available from low-intensity reflecting arcs, fixed by the subliming temperature of carbon. It has been determined that the maximum brightness temperature of the positive crater of the carbon arc is approximately 3810°K. Fig. 1 shows the energy distribution curve of the low-intensity carbon arc operated with 12-mm. positive and 8-mm. negative carbons at 30 amperes, 55 volts, d.c.; and, for comparison, the theoretical curve of black body radiation at 3810°K. It is apparent from these curves that, with the exception of the peaks at approximately 2500 and 3900 A, which are characteristic of all carbon arcs, the energy distribution from this arc is a close approximation to the theoretical limit. The maximum intrinsic brilliancy under the conditions defined is slightly less than 175 candles/mm.

High-Intensity Arcs.—The high-intensity arc is not subject to the same limitations as the low-intensity arc. Introduced to the motion picture industry more than 15 years ago, it has been described and its characteristics discussed in numerous papers. The high-intensity arc is operated at much higher current-densities in the electrodes than is the low-intensity arc. The positive carbon burns with a deep crater and is provided with a central core containing rare-earth minerals. The vapors from this core, confined by the arc stream to the cup-like crater, attain a brilliancy far greater than that associated with the temperature at which carbon sublimes. The result is a snow-white light and a crater brilliancy much higher than that attainable in the low-intensity arc.

In the larger high-intensity arcs, the brilliancy of the crater exceeds 800 candles/mm. From Fig. 2, which shows the energy distribution of a typical high-intensity arc, it is evident that the colors are more evenly balanced and the light consequently whiter than that of the low-intensity arc.

The larger theatres were prompt to make use of the greater volume and improved quality of light that the high-intensity arc provided. However, its use for projection in small theatres was not practicable, from an economic standpoint, up to 3 or 4 years ago. The first important extension of the high-intensity principle of arc operation came with the

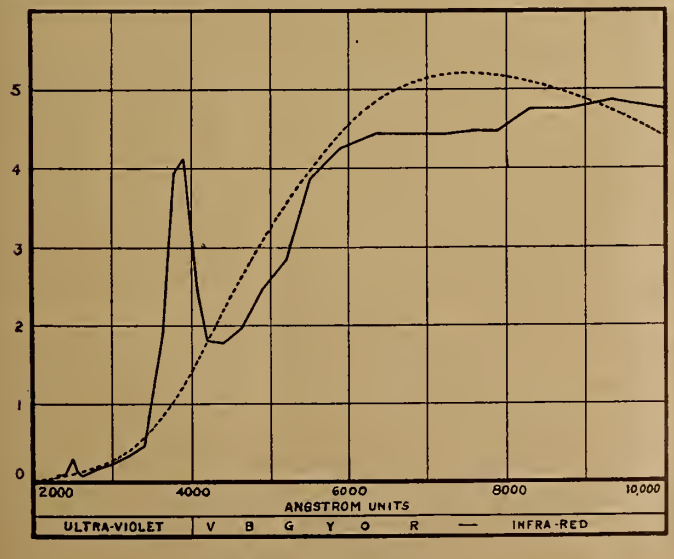


FIGURE 1

Energy distribution from low-intensity arc: (solid line) 30-ampere, 55-volt, d-c. arc, 12-mm. pos.; (dotted line) radiation curve of theoretical black body at 3810°K.

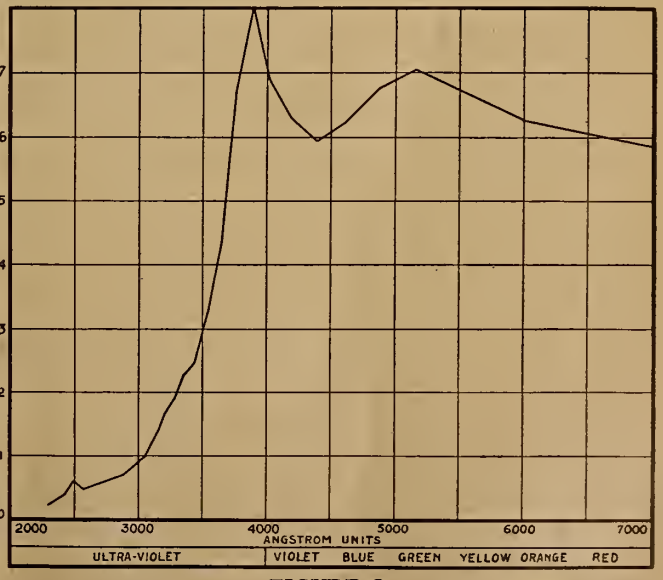


FIGURE 2

Energy distribution from high-intensity, 125-ampere, 63-volt, d-c. arc; 13.6-mm. positive carbon

development of the a. c. high-intensity carbon, which was followed shortly by the Suprex arc—a similar carbon designed for d. c.

Both these new carbons are copper-coated and of smaller diameter than the carbons previously used in high-intensity arcs. They are operated without being rotated, and are gripped at a point remote from the arc. Prompt development of lamps for their use placed high-intensity light-sources for the first time within the economic reach of the small theatre.

Advantages of H. I. Projection

The experience of theatres that have used high-intensity projection has demonstrated that it possesses two distinct advantages. First, the snow-white quality of the screen illumination has proved much more pleasing to the audience than the somewhat yellow tint characteristic of the low-intensity arc. Second, the higher level of general illumination permitted by the increased screen brightness adds greatly to the comfort of the patrons entering the theatre. These advantages are rapidly extending the use of the high-intensity arc in the smaller theatres, displacing the low-intensity, reflecting arc which, in recent years, has practically monopolized this field.

Super H. I. Arc.—For some time there has been a demand by a number of the larger theatres for still greater screen illumination than can be supplied by the 13.6-mm. high-intensity arc operated at 120-130 amperes. Screens well over 40 feet wide are now being used in some theatres. Since the intensity of screen illumination than can be supplied by projected light varies inversely as the square of the image width, it is apparent, from the example cited earlier, that these large screens require a light-source of tremendous power.

This latest demand for more projection light has been met by the development of a 13.6-mm. super-high-intensity carbon†. This carbon is adapted to steady operation over a current range of 140 to 190 amperes. At the upper range of current it provides 30 per cent more light than the regular 13.6-mm. high-intensity carbon at 130 amperes. There is also a more uniform distribution of brilliancy over the crater face of the new carbon, with a resultant improvement in the distribution of screen light.

Improvements in Lamps

In addition to the improvements in carbon electrodes, there have been notable improvements in projection lamp design during the last few years. Among these are improved feeding mechanisms, closer control of the arc position, magnetic stabilization of the arc stream, and increase in light pick-up. Old type, low-intensity lamps pick up a cone of illumination about 45 degrees in extent. The low-intensity reflecting arc increased the angle of collection to 106 to 120 degrees. Reflecting types of high-intensity arc use mirrors having collection angles of 95 to 122, and condenser types, 69 to 79 degrees. The smaller angles of pick-up in the latter are to some extent compensated by lower ratios of magnification.

The latest lamps, designed for the new a.-c. high-intensity and Suprex carbons are using mirrors picking up light over angles as great as 145 degrees. The optics of projection place limits upon the extent to which this trend toward greater angles of pick-up can be carried. The improvements that have been made, however, have been a substantial factor in making higher intensities of screen illumination available.

Studio Lighting Advances

The development of the studio carbon arc, using metal-coated, white-flame carbons, has been discussed. Although essentially a flame type of arc, the broadside studio arc is operated under conditions quite different from those applying to the regular white-flame photographic carbon arc. Improved design eliminates all lamp noises and fulfills every demand of sound picture production. At the usual operating current of 35 to 45 amperes, the ½-inch regular white-flame photographic carbon carries a current-density of 180 to 200 amps./in., whereas the current-density in the metal-coated carbons of the studio arc at 35 to 40 amperes is 450 to 515 amps./in. This is comparable to the current-density in many high-intensity arcs.

While this new studio arc can not be defined as a high-intensity arc, because it lacks the well-defined crater and the characteristic gas-ball of the latter, the character of the light emitted differs materially from that of the regular white-flame carbon, as may be seen in Fig. 3. In quality of light this studio arc has many of the characteristics of the high-intensity arc. It has photographic effectiveness and excellent color balance for monochromatic as well as for color productions.

Sun arcs and rotary spots using the high-intensity arc have been greatly improved to adapt them to the sound stage. A new high-intensity rotary spot of compact design combines the ideal beam characteristic of the condenser-type lamps with the high power of the reflecting arcs. By means of an improved optical design, which includes the use of a modified Fresnel type of condensing lens, this lamp makes use of a much higher percentage of the total light from the source than the older condenser lens designs.

This design entirely eliminates the often-troublesome shadow of the negative carbon and its support, and provides a range of beam-spread from a 4-degree spot beam to a 44-degree flood, without dark spot or rings. Regardless of spread, the highest intensity of the beam is always at the center, falling off smoothly toward the edges. Such a beam can very easily be blended with the beams from adjacent lamps. The carbons are fed continuously, maintaining uniform arc voltage and arc gap, so that the arc burns without change of intensity or color. The carbon-feeding mechanism has been made sufficiently silent to permit operating the lamps at normal speed within 10 feet of the microphones.

The new super-high-intensity arc is rapidly finding application in the studio for background projection, in which the increased volume of illumination is of distinct advantage. There is further advantage in the wide range of current over which steady operation obtains, permitting adjustment of the projection light to compensate for a wide variation of density in the film projected upon the background screen. Upon the basis of increased light output, as well as perfect color balance of the light, the adaptation of this new arc to stage illumination in motion picture production likewise seems to be indicated.

VOLUME CONTROL A DELICATE UNIT

Never open a volume control in an attempt to improve upon its internal construction, since the element and contact member are delicate and must not be touched, scraped or tinkered with. Also, never apply oil to surface of resistance element because this will ruin the resistance and the control will no longer function properly.

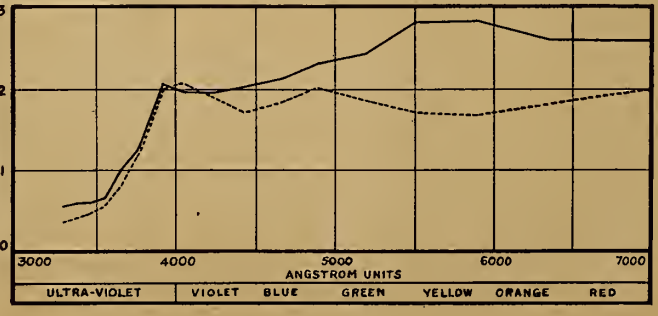


FIGURE 3

Energy distribution from photographic carbons: (full line) 8-mm. metal-coated, white-flame, studio carbons, 40 amperes, 37.5 volts d-c.; (dotted line) 13-mm. regular white-flame photographic carbons, 35-amperes, 37.5 volts d-c.

† I. P. for June, 1936, p. 7.

TECHNICAL AND ECONOMIC ASPECTS OF COPPER-OXIDE RECTIFIERS

By *C. E. HAMANN*

COMMERCIAL ENGINEER, GENERAL ELECTRIC COMPANY

First to acquaint the field with the application of copper-oxide rectifiers as a source of power supply for projection*, I. P. now presents additional and more explicit data thereon. The appended paper, originally presented before the S.M.P.E., presents data on the design, construction and operating characteristics of c.-o. rectifiers which should make for maximum efficiency in operating these units.—*Editor.*

THE application of the copper-oxide rectifier as a d. c. power supply for projection is by no means new. A fan-cooled type of copper-oxide rectifier was developed by General Electric in 1930, and applied successfully to the low-intensity type of lamp as well as the hi-low lamp.[1] With the advent of the Suprex type of arc an entirely new field has been opened up. The characteristics of the copper-oxide rectifier have been found to be admirably well adapted to the special voltage and current requirements of the Suprex arc.

In construction, the transformers and control panel are assembled as a unit and located in the upper part of the casing. The copper-oxide stacks, together with the air baffles and the blower system, are also assembled as a single unit and installed in the lower part of the casing. Aside from these two unit assemblies, the only other parts are the control relays and protective switch.

It has been pointed out that single-phase rectification is not suitable for the Suprex arc due to the pronounced ripple in the d. c. voltage output.[2] Hence, copper-oxide rectifiers for Suprex supply have been developed for polyphase service only. The rectifier circuit is designed for full-wave rectification of all three phases of the a. c. supply, and the resulting d. c. output has a ripple of relatively low magnitude and high frequency (360 peaks per second for 60-cycle, 3-phase).

The only noticeable effect of the d. c. ripple is a slight "sing" to the arc, which, it has been determined experimentally, can be eliminated by a small reactance filter in the d. c. circuit. However, visual inspection supplemented by photo-metric tests indicate that the ripple is not of sufficient magnitude to cause any discernible effect in the light upon the screen. Therefore, the additional cost of a filter reactance does not appear warranted, and is omitted in the commercial design.

A typical circuit diagram of a 3-phase unit is illustrated in Fig. 1. The transformer connections are arranged delta-delta. Units for 2-phase service differ only in transformer design. A Scott-connected transformer changes 2-phase to 3-phase, so that the rectifier circuit and the output characteristics are identical to those of the 3-phase unit and therefore need not be discussed separately.

Circuit Design Data

An examination of the wiring diagram will readily disclose the general scheme of the rectifier circuit, but a brief explanation of the control circuit may be in order. It will be noted that the blower motor and the relay holding coils are energized from a separate 110-volt, single-phase circuit. The purpose is two-fold: (*a*) it provides a simple remote-control arrangement for starting and stopping the rectifiers, and (*b*) it permits operating the rectifier on 2 phases in the event of failure of any one of the phases of the 3-phase a. c. supply line.

In the design of a copper-oxide rectifier it is customary to base all calculations upon established data for the "unit bridge."[1] For a single-phase circuit a "unit bridge" consists of four disks or elements arranged in a full-wave "bridge" circuit as shown in Fig. 2*a*. For a 3-phase circuit, with which this paper is chiefly concerned, the "unit bridge" consists of 6 disks arranged in a 3-phase full wave "bridge" as shown in Fig. 2*b*.

Experience over many years has resulted in establishing certain standard limits of voltage, current, and temperature for the unit bridge. Thus, dividing the safe voltage limit of the unit bridge into the desired voltage rating indicates the number of disks that must be connected *in series* in each leg of the bridge circuit. Similarly, the current limit of the unit bridge divided into the desired

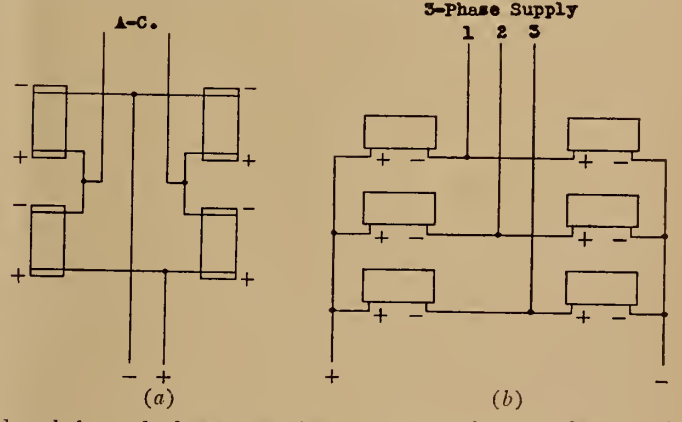


FIGURE 2

(a) *Arrangement of single-phase "unit bridge" circuit;* (b) *arrangement of three-phase unit-bridge circuit*

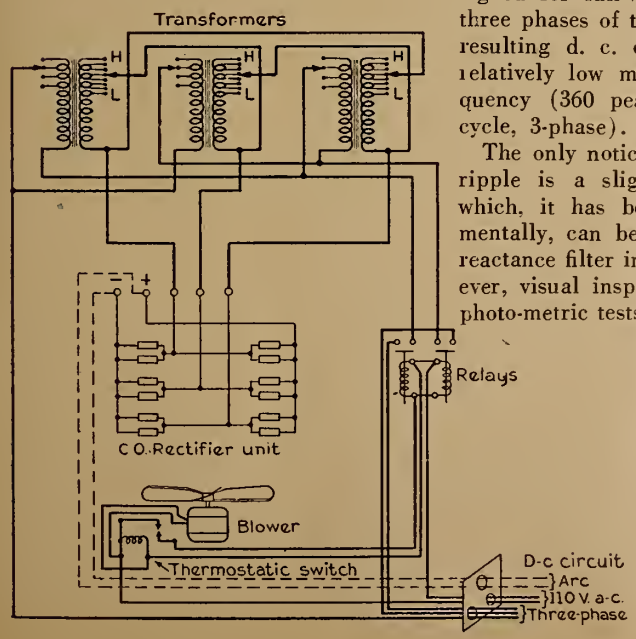


FIGURE 1

Standard arrangement of internal wiring of three-phase copper-oxide rectifier for motion picture projection

* I. P., 8 (March, 1935) No. 3., p. 15.
9 (Dec. 1935) No. 6, p. 18.

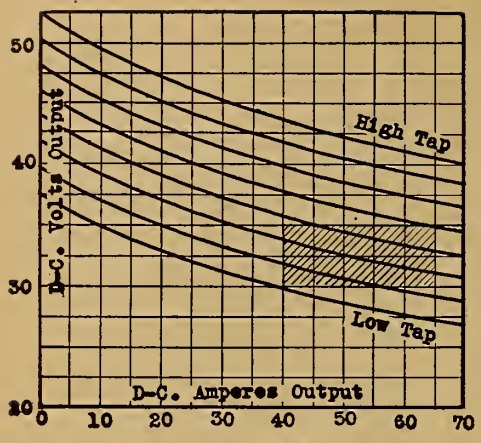


FIGURE 3

Volt-ampere output characteristics of standard 65-ampere copper-oxide rectifier

current rating indicates the number of *parallel* groups of disks required in each leg of the bridge circuit.

The problem of design would be simple except that consideration must be given to the so-called "aging" characteristic of the copper-oxide element.[1] This can be defined as a gradual increase of resistance of the unit in the "forward" direction which tends to stabilize after 4,000 to 5,000 hours use.

Aging is a function of temperature as well as of time, and the higher the operating temperature the greater will be the change of resistance before stabilization takes place. It is at once apparent that in order to maintain the initial output of a unit it will be necessary to increase somewhat the applied a. c. voltage after aging has taken place.

Care must be taken in the design to make sure that the final applied a. c. voltage necessary to maintain the rated output after aging will not exceed a safe value for the particular disk combination under consideration. Fortunately, sufficient data have been collected over a period of years to predict with reasonable accuracy the amount of aging that will take place for any given conditions of temperature.

In the commercial design (Fig. 2) eight taps are provided on each transformer secondary winding, making it possible to adjust the applied a. c. voltage in steps of approximately 2 volts. This serves the dual purpose of permitting a wide range of output adjustment and a ready means to compensate for aging.

In Fig. 4 is shown a family of curves giving the d. c. volt-ampere output regulation for each of the eight secondary taps on a standard 65-ampere unit. These curves illustrate the inherent regulation of this type of rectifier that makes it possible to operate without any form of external ballast in the arc circuit. It will be seen that the entire range of output, from 40 to 65 amperes, 30 to 35 volts, can be covered with the five lower taps, leaving three additional taps to compensate for aging, an amount that experience shows is more than ample.

C.-O. Operating Efficiency

The efficiency of a copper-oxide rectifier is regarded as the ratio of the d. c. watts' output to the a. c. watts' input. The losses in the rectifier consist of resistance losses in the forward direction through the copper-oxide elements, leakage in the "blocking" direction, and transformer losses. In the case of the fan-cooled motion picture rectifier, the power consumed by the fan motor and the control relays should be added to the input to obtain the true over-all efficiency. Resistance losses in the copper-oxide elements represent the major part of the total losses. It has been previously shown that this resistance tends to increase with age up to a certain stabilizing point. It is at once obvious that aging tends to reduce somewhat the initial efficiency.

There is no rule-of-thumb method of stating the new and aged efficiencies of any rectifier, because the difference depends upon the ratio that the rectifier resistance bears to the total impedance of the rectifier-load circuit. If the rectifier resistance is a small part of the total impedance of the circuit, then a considerable change in rectifier resistance will mean only a slight change in the total impedance of the circuit, and consequently only a slight change in efficiency.

Aging being a function of temperature, an adequate system of forced ventilation will permit operating at a considerably higher current-density per unit bridge than would be the case with the conventional air-cooled type of unit. Tests on fan-cooled units operating at various current densities continuously since 1929 have given the necessary data for establishing safe limits with respect to current density and temperature.

With a fan-cooling system capable of limiting the temperature rise of the copper-oxide elements to a maximum of 2 or 3 degrees C., a maximum current density of 2 amperes per unit bridge (3-phase) appears safe. It may be concluded that under these conditions it will not be necessary to apply an a. c. voltage in excess of 8 volts per unit bridge in order to maintain an output of 7 volts d. c. per unit bridge after aging has taken place.

Figure 4 shows the over-all operating efficiency of a standard 65-ampere unit (new) and includes the power consumed by the fan motor, relays and protective switch. Fig. 5 shows the upper and lower limits of the predicted efficiency *after aging has taken place.* It should be kept in mind that several thousands of hours of continuous use are required before the aging begins to approach stabilization, and this, measured in terms of theatre service, is a matter of years.

Inspection of Fig. 4 indicates a somewhat higher efficiency at 40 amperes than at the full-load point of 65 amperes. By increasing the number of parallel groups, and in this way reducing the current-density per unit bridge, it would be possible to make the point of maximum efficiency coincide with the full-load point on the curve; but the increase in size and cost of the unit would more than offset any possible advantage from the slight gain in efficiency.

On the other hand, any attempt by the designer to economize on materials by reducing the number of parallel groups and increasing the current-density per unit bridge will mean increasing the impressed voltage to a point in excess of the maximum safe limit of 8-volts per unit bridge, thus introducing a risk of possible breakdown by puncturing the oxide film.

Long Life Forecast

It has been frequently stated that a copper-oxide rectifier properly applied will last indefinitely. Factory life-tests now running into the tenth year as well as hundreds of different industrial applications all tend to bear out this claim.† The percentage of troubles in the field has been gratifyingly small, and such troubles as have occurred are usually traceable either to misunderstanding the operation of the unit or to overloading due to inadequate wiring and equipment.

There are at the present time upward of 600 G. E. motion picture type copper-oxide rectifiers in the field, furnishing ample proof of the acceptance of this type of equipment by the industry. Good engineering and strict adherence to the design limits described above should result in a high degree of reliability, exceptionally long life, and freedom from trouble.

Aging, if given proper consideration when designing the rectifier, will result in only a small reduction in operating efficiency over a period of years. A careful check of a number of units in

† "Now there are operating on test hundreds of units of various types from 1 to 10 years old, all of which have given the same answer, namely, that the life of the rectifier when properly applied is indefinite. The performance with time of a Rectox used to operate a printing telegraph will serve as an example. In 3 years of continuous operation at full load, the output has dropped off only 7 per cent. Tests made on a standard 3-phase elevator-control c.-o. rectifier, so far covering 27,600 hours of operation, show similar results. The rectifier was connected directly to the a.-c. line without intervening resistance, and no adjustment of voltage or load is ever made. In a 7½-year test, or 65,000 hours, a number of 2-ampere, 6-volt battery chargers are still delivering rated output, with no indication of any limit to the life of the rectifier."—SMITH, I. R.: "Copper-Oxide Rectifiers for Motion Picture Arc Supply," *J. Soc. Mot. Pic. Eng.*, (Sept., 1936) p. 331.

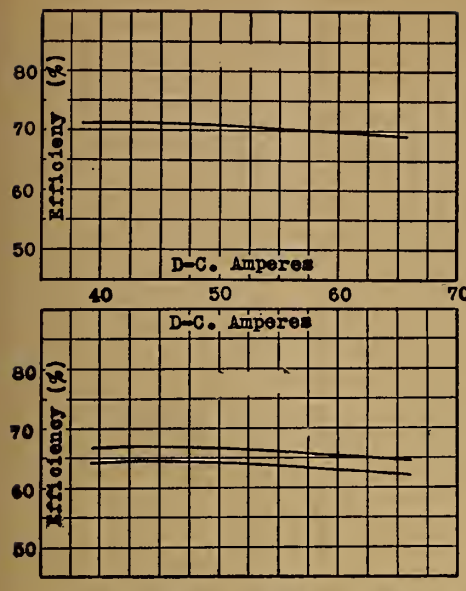


FIG. 4 *(above): Efficiency (new) of standard 65-ampere c.-o. rectifier*

FIG. 5 *(below): Upper and lower limits of predicted efficiency of standard 65-ampere c.-o. rectifier*

service for more than a year indicates that they are still maintaining their original output with no change in adjustment.

The Projection Practice Committee of the S.M.P.E[2] early recognized the merits and advantages of the copper-oxide rectifier, and others who unhesitatingly predicted its success in the motion picture field are seeing their predictions well on the way toward fulfillment.[3]

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[1] Harty, E. A., and Hamann, C. E.: "Fundamental Characteristics and Applications of the Copper-Oxide Rectifier," *General Elect. Rev.*, 36 (Aug., 1933), No. 8, p. 342.

[2] Report of the Projection Practice Committee, *J. Soc. Mot. Pict. Eng.*, XXIV (Jan., 1935), No. 1, p. 35.

[3] "Copper-Oxide Rectifier for Projection Arc Supply," *Internat. Projectionist*, 8 (March, 1935), No. 3, p. 15.

"He Laughs Best—"

The splendiferous new Criterion Theatre on Broadway, N. Y. City, opened recently with projection room portholes about 7 inches too high for projectionists of average size. Reason: a certain distinguished projection man, having laid out the new Rialto Theatre projection room, was asked to "make suggestions" for the Criterion job. The projection man asked to be paid for the job. The architect couldn't see this at all. Remembering the Rialto job, he obtained that layout. But he overlooked the fact that the Rialto has nearly level projection, while the Criterion has the usual angle.

Result: the Criterion crew will inaugurate a new technique: making change-overs while standing on a box.

REEL LENGTH A MINOR PROJECTION PROBLEM; PRINT DENSITY, SOUND LEVEL ACUTE

By *THAD C. BARROWS*

PRESIDENT, PROJECTIONIST LOCAL UNION 182, BOSTON

NOW that the exhibition field has been "saved" from the terrors of single-reel projection by the Academy of M. P. Arts & Sciences—a danger existing almost exclusively in the minds of Academy technicians—this distinguished technical group might consider certain deficiencies in the production field the results of which are much more serious in terms of dollars and cents than any lack of standardization in reel lengths.

It might be noted in passing that no great success has attended Academy dabbling in exhibition technical matters to date; in fact, its co-ordinating activities have been badly botched. It began tinkering with reel lengths more than five years ago, and its futile groupings with both the S.R.P. and standard aperture are too recent to require extended comment herein. Now, several weeks after its "nation-wide" introduction. the double reel is as much an industry standard as is horse-radish.

Improvement in the S.R.P. and some degree of control over release print sound levels and density are projects which are, or should be, much nearer home for the Academy than the question of projection reel length. Any print of the picture "The Road to Glory" (Fox-20th Century) would provide the Academy with a perfect subject for its research talents. Granting that the lighting of this overstuffed glorification of war was intended to establish and maintain a rather sombre mood, the fact remains that certain scenes therein are hardly visible even with 125-ampere, high-intensity projection, the sound level varies from 2 to 8 points, and the change-over marks were indistinguishable. This particular release is a conspicuous example of the faults to be found in many release prints, the correction of which would be many times more beneficial to both producers and exhibitors than any change in reel length.

That other great achievement of the Academy, the S. R. P., was adopted in 1930. Although revised several times since then, the S. R. P. today is not functioning in the manner intended. The present 10-inch reel has a capacity of 1000 feet, yet distributors persist in mounting less than 500 feet on these reels. Is there any doubt that the same thing will happen with the 14½-inch reel?

The S. R. P. originally was intended to provide visible starting and change-over marks—to aid projectionists, if you please. The continuing flagrant abuse of the original specifications actually hampers, instead of aiding, projectionists. S. R. P. markings now are more useless than ever: marks continue to be placed on moving objects or on dark portions of scenes. The writer (handling new prints) often finds it impossible to detect these marks; he can only sympathize with projectionists in subsequent-run theatres. Some features have three or four changes of scene between change-over and starting marks, a practice supposed to be taboo under S.R.P. specifications.

Ninety per cent of film mutilation is charged to either projectionist incompetency or the joining of single reels. I have never subscribed to this theory. Is incompetency or doubling responsible for "rain," aperture scratches, rips, tears, evidences of sprocket-riding or any other marring of the face of the film? It occurs to the writer that worn or defective equipment is responsible for such damage, apart from economy drives which result in serious print shortages.

These defects are much more distracting and annoying to theatre patrons than an occasional change-over. Yet the Academy, possessing excellent producer-distributor connections, has never moved to give force to repeated distributor mouthings that damaged film would be billed to theatres. Maybe it is impolitic to lock horns with the distributors' theatre customers. The fire authorities would welcome distributor insistence upon equipment standards.

The writer has never accepted the principle that projection standards—whether relating to reel length or any other phase of the art—should be set by either the Hays Office, the Academy or, for that matter, any engineering society. Specifically, he has little confidence in the ability of the Academy to promulgate projection standards, because every such project launched by the Academy came East in "final" form only to have its face lifted by projectionists before it was applicable to practical projection work. Either the Academy is not in touch with practical projectionists or it disdains their advice.

Finally, the writer favors the formation of a strictly projectionist group which, if it didn't actually establish standards, could at least originate proposals having some basis in the necessities of practical theatre projection work. But this is another story. Meanwhile, it appears that there are reproduction problems vastly more important than reel length demanding attention.

AN INQUIRY INTO THE KNEISLEY L. I. LAMP 'CONVERSION' PROCESS

Substitution of Larger Reflectors No Guarantee of Increased Screen Light

FOREWORD: The Kneisley Electric Co., of Toledo, Ohio, advertises in the general trade press, by direct mail and through its representatives that its "conversion process" will increase the light output of a low-intensity lamp from 58% to 72% (and more in some instances)—at a cost of about $30 per lamp. The "Kneisley Process," it appears from the advertising, involves the substitution of 10¼-inch reflectors for the 8-inch reflectors used in the early models of low-intensity lamps. A representative Kneisley advertisement is quoted here:

"10¼" REFLECTORS FOR LOW-INTENSITY LAMPS
Strong-Motiograph-Brenkert-Powerlite-Peerless

We're telling you that you have been throwing away 50% of all the light you have been paying to generate. 10¼" Reflectors will give you 50 to 60% more light without increasing your operating costs one penny; 80% more light if you use SRA Carbons at 30 amperes.

Carbon Comb.	*Arc Amperage*	*Average Screen*	*Screen Illumination 7⅝ or 8 in. Refl.*	*10¼ in. Refl.*
7 & 10 mm.	18	18 ft.	7 ft.-cdls.	10.5 ft.-cdls.
8 & 12 mm.	25	18 ft.	8 ft.-cdls.	12.5 ft.-cdls.
8 & 12 SRA	30	18 ft.	9 ft.-cdls.	15 ft.-cdls.

Reflectors by BAUSCH & LOMB *Equipment by* KNEISLEY ELECTRIC CO."

Installation instructions for this process state that the reflectors are the finest available, being made by Bausch & Lomb, to whom "complaints" will be referred to assure customer satisfaction.

Numerous inquiries anent this process having been received from the field, I.P. invited Mr. Kneisley to explain the procedure in a contribution to these columns. Appended hereto is his contribution; and immediately following is a discussion of the various interesting points raised by Mr. Kneisley.—*Editor.*

By *R. F. KNEISLEY*

THE increases in light given in our advertising matter (see sample in foreword to this article—Ed.) are given in percentages and represent results obtained through actual measurement in the field. Various results are obtained with different lamphouses, naturally, depending upon the reflector size that the theatre is using.

We base our advertising on results obtained by photometric readings, and generalize a theory thereafter. This theory is readily understood, we believe, when considered from the standpoint of reflector *area* rather than *diameter*.

The 7⅝-inch reflector, as used in the Peerless low-intensity lamp, has a total area of approximately 46 square inches; whereas a 10¼-inch reflector has a total area of 83 square inches—an increase in area over the smaller reflector of approximately 80%.

Total Light Increase of 72%

In a polar curve taken in a conical position around the arc, it will readily be observed that useful light in large quantities is available through the included angle of 145 degrees. The 10¼-inch reflectors have a light angle of 132 degrees, as compared with the angle of 90 degrees of the 7⅝-inch reflector. If the distribution curve was uniform throughout its entire length, theoretically there would be present an increase of 80% in reflected light, as a result of substituting the larger reflector. However, since the distribution curve tapers at its extremities, the actual light increase brought about by the increased reflector diameter (of the 10¼-inch mirror) is 58%.

By removing the condensing lens necessary in Peerless lamps, a light increase of 14% is realized, since there is a 7% light loss through each change of medium (two, in this case) through which the projected light must pass. This 14%, added to the 58% gained through increased reflector area, makes a total gain of 72% in screen illumination. This figure can be increased to 80% through employment of SRA carbons at 30 to 32 amperes, which set-up is optional.

The same results are obtained in the case of larger reflectors, *i. e.*, the change from 8-inch to 10¼-inch reflectors will increase the projected light by about 56%, using 8 x 12 regular carbons, and to about 70% when 8 x 12 SRA carbons are used. The figure of 72% is the maximum gain claimed by us.

Very conclusive proof of the merits of this process is available from either the Sparks-Publix or the Warner Theatres circuits, which are installing 10¼-inch reflectors in all their low-intensity lamps. Since the first of the year we have distributed more than 2,600 reflector equipments. Actual measurements made at the Plaza Theatre, Sandusky, showed an actual increase in light of 72%, as measured by a Weston Photronic Foot-Candle Meter.

Installation Instructions

[Excerpts from the installation instructions issued by the Kneisley Co., which may help to further explain this process, are appended hereto: "Take the bakelite knob from the old screws and place them on the special milled shaft. This will enable you to burn the carbons very short . . . In extreme cases use the special nose castings, particularly where you are using very long focal length lenses. Any light striking the

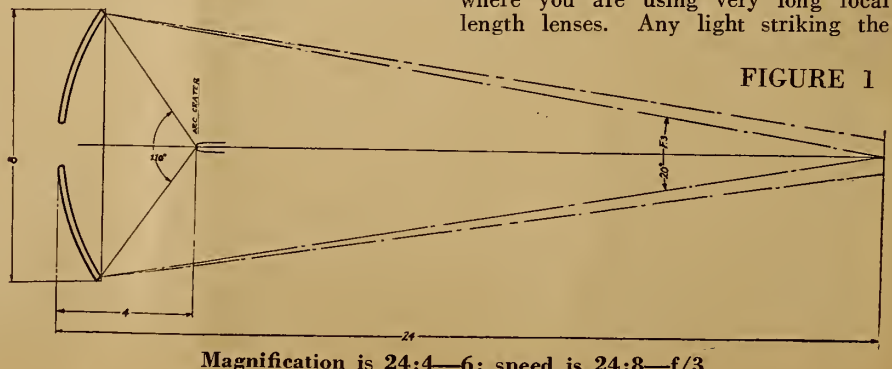
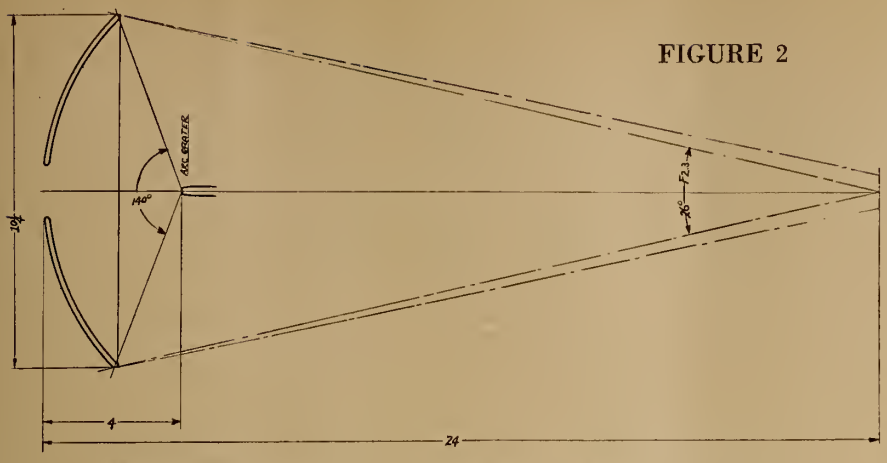


FIGURE 1

Magnification is 24:4—6; speed is 24:8—f/3

FIGURE 2



Magnification is 24:6—6 times; speed is 24:10¼—f/2.3

inside of the nose casting will not be projected to the screen.

"A larger diameter reflector increases the speed of the optical system, consequently a different setting is required for the new reflector equipment. HALF-SIZE LENSES, having large front and rear factors (except in cases where the focal length is exceedingly short) are almost compulsory to obtain the total amount of light reflected by the new mirrors, because the angle at which the light beam strikes the film aperture is so great that only a small portion of the beam can enter the rear factor of the small quarter-size lens. Be sure that you have HALF-SIZE LENSES.

"Slide the entire lamphouse ahead until the back surface, or vortex, of the reflector measures about 25" from the film aperture. The exact distance will depend upon the focal length lens you are using. If the lens is 4" to 4½" E. F., the vortex should be approximately 24" from the film line. At 4¾" to 5" E. F., the vortex should be approximately 25". At 5" approaching 6" E. F., 26", *etc.*

"This setting can best be determined by the projectionist, various results being obtained for different lenses. Be sure, however, that you have not placed the reflector so close to the film line that you are more than filling the lens. This will result in light loss inside the lens barrel, and it will become excessively warm. By placing a white card in front of the lens and moving the entire lamphouse ahead and back, you can readily find the spot or setting at which the lens is just filled."]

Consideration of the foregoing contribution by Mr. Kneisley opens up a vast field of speculation relative to lamp design, light-pickup angles, reflector diameter. lens speed, *etc.*,—all of which is of absorbing interest to the practical projectionist. The appended comments, and accompanying illustrations, are an attempt to clarify some aspects of this problem.—*Editor.*

THERE is nothing new or startling about the Kneisley conversion process. It simply utilizes a 10¼-inch reflector which is exactly the same as those used in all late-type, low-intensity lamps, and applies it by means of various accessories to early-type lamphouses. Several of the Warner theatres, cited as references, report a 40% light increase through use of this equipment, a figure which Mr. Kneisley subsequently revised upward by 20%. Discussion of percentages, however, will lead nowhere; what is required is a delving into known fundamentals of light projection.

When the first low-intensity lamps were designed and put on the market, the average projection lens had a working speed of *f*/3. Accordingly, the lamps were designed to match the lenses in common use at that time.

Figure 1 shows the optics of the old Stanard low-intensity lamp which was the original production of Strong Electric Corp. This lamp has not been manufactured by Strong for several years. It will be noted that this reflector has a light-pickup angle of 110 degrees and a working speed of *f*/3, which, as mentioned previously, was correct for the average projection lenses in use at that time.

Figure 2 shows the optics of the current model Strong Utility lamp. This lamp has a reflector 10¼-inches in diameter, a light-pickup angle of 140 degrees and a working speed of *f*/2.3, which is designed to match the modern projection lenses having a like working speed. This increased light-pickup angle and increased lens speed does result in some increase of light on the screen, although the figure of 72%, or even 40%, is much more than could be hoped for on anything like the average installation. This is the reflector that Mr. Kneisley is substituting for the 8-inch reflectors in his conversion process.

Comparative Test Inconclusive

For the convenience of the reader and as an interesting comparison, there is included herein Fig. 3, which shows the optics of the Strong high-intensity Mogul lamp. Fig. 4 is an unofficial layout of the Peerless (McAuley) low-intensity lamp, which has a pickup angle of 110 degrees and a working speed of *f*/2.6.

Figure 5 is an accurate representation of what would happen if a 10¼-inch re-

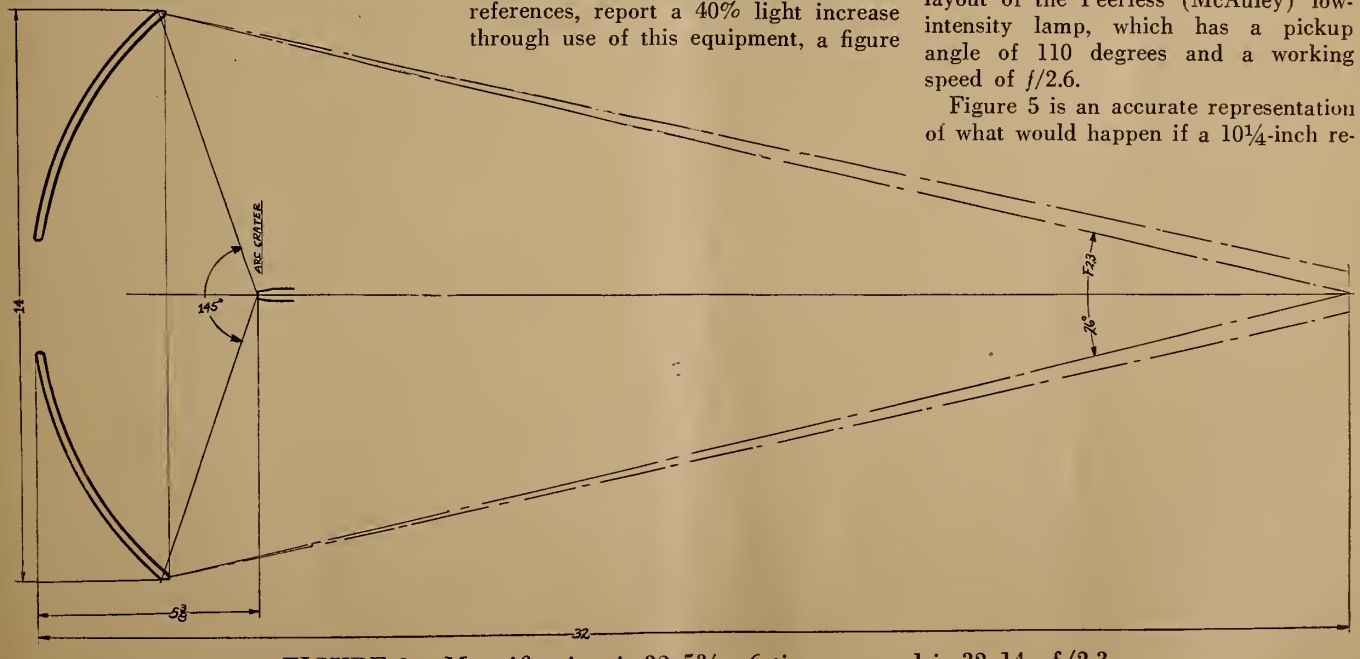


FIGURE 3. Magnification is 32:5⅜—6 times; speed is 32:14—f/2.3

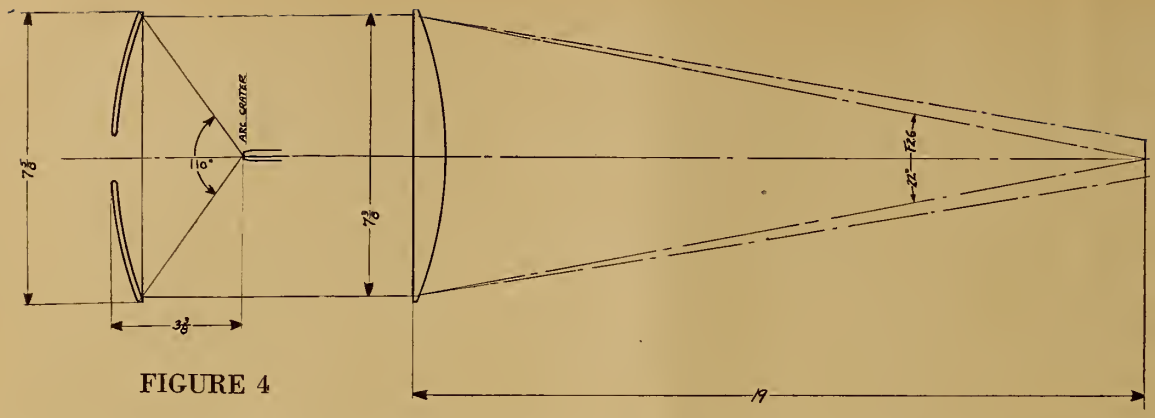


FIGURE 4

Magnification is 19:3⅜—6 times; speed is 19:7⅝ —f/2.6

flector were set up in combination with quarter-size lenses having a working speed of *f*/3. It could safely be said that there would be no gain whatsoever in pickup angle and speed, and accordingly there would be no increase in light. All of the reflector area beyond the 8-inch limit would be wasted.

Mr. Kneisley kindly offered to supply a complete equipment for making tests to determine the relative merits of a Kneisley-equipped lamp and one not so equipped. This offer was not accepted, because the results of such a test would be inconclusive, for several reasons. First, the test would involve a comparison of a new mirror with an old one, the latter being several years old and not having the accuracy of curvature that is obtainable today. Comparison between an old and a new 8-inch mirror in the same lamp would show a substantial increase in light for the latter because of its newness and accuracy.

Further, the results of this test would depend on several other conditions which might vary from one installation to another. Among these would be the speed and focal length of the projector lens. If one happened to get a combination that just matched with the 10¼-inch reflector, and if the lamp happened to be set back from the aperture so that the angles of light from the reflector and the speed angles of the lens just about matched, then one would obtain a considerable increase in light. However, if there happened to be an especially long or especially short focus, the speed probably would not match and the increased light on the screen would hardly be noticeable.

At least one lamp manufacturer is now making reflectors; and if this conversion process were so attractive, he probably would have gone into it. It is no trick to cut the notches out of mirrors, and they could easily be produced. Close inspection of such conversion processes, however, invariably reveals some defect.

Figure 6 is a light distribution curve from a carbon arc showing angles of 110 and 140 degrees, providing an interesting comparison of light loss between the two angles; in other words, between an 8- and a 10-inch reflector.

Mr. Kneisley states very definitely, and so advertises, that the light projected upon the screen is in direct proportion to the area of the reflector. Obviously this statement is not accurate, because this additional reflector area must be so positioned that it can pick up some light. Assuming that we went to a 180-degree angle: reference to Figure 6 will show that at such extreme angles there is practically no light to pick up. It follows, therefore, that any angle beyond 140 or 145 degrees would represent a total waste; as a matter of fact very little light is gained beyond 110 degrees.

During the last several years, and since high-speed projection lenses with working speeds of *f*/2.2 to *f*/2.5 have been in common use, all modern projection lamps have utilized reflectors of like optical speed to match these fast lenses. It is simply the natural thing to do, and no lamp manufacturer has ballyhooed the practice. The increase in light thus obtained is worth while, of course, especially when projection lenses are of correct speed.

Showing effect of using a 10¼-inch reflector in combination with an f/3 lens. This results in no increase of light over an 8-inch reflector

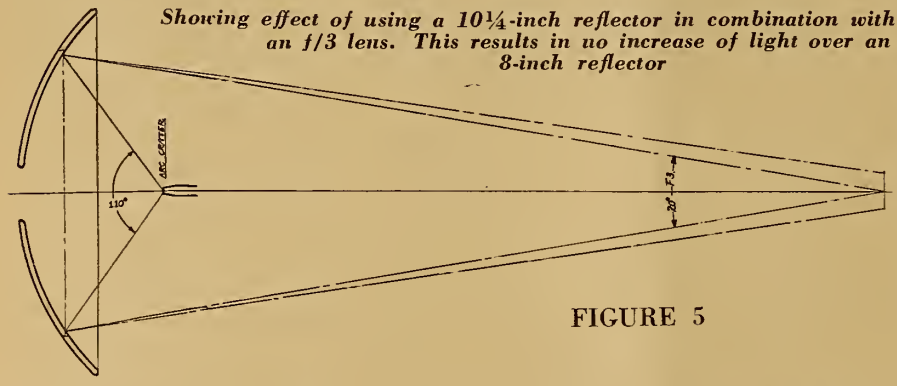


FIGURE 5

No Single 'All-Around' Mirror

In the same series and make of lenses, however, the speed varies considerably with different focal lengths: thus there is no such thing as an *exact-diameter* reflector which must be used to secure all-around efficiences. The 10¼-inch re-

(*Continued on page* 25)

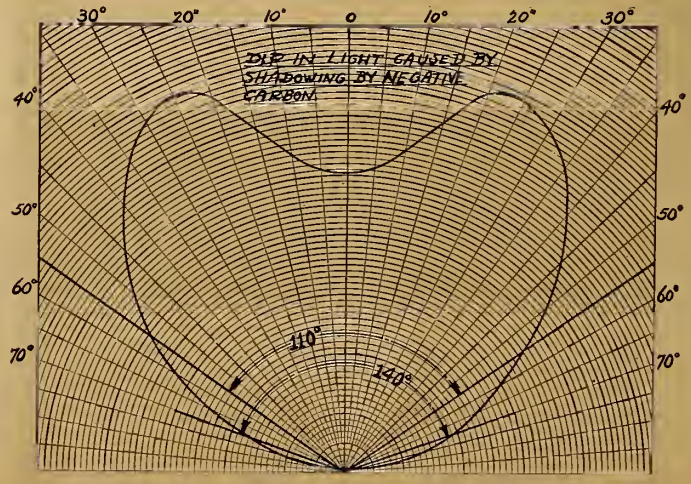


FIGURE 6

Light distribution curve for carbon arc showing relative light - gathering ability within 110° and 140° pick-up angle

The lp EDITORIAL PAGE

Vol. 11, No. 3 SEPTEMBER 1936

Larger Mirrors No Guarantee of Better Results

Careful consideration of the Kneisley process for "converting" low-intensity lamps so as to increase the light output, discussed elsewhere herein, suggests several questions the answers to which should serve to resolve any doubts as to the desirability of this process. Mr. Kneisley's statement that more than 2,600 theatres have favored his process makes this matter of more than casual interest. First, since all modern low-intensity lamps use 10¼-inch reflectors, why all the current excitement about such an adaptation? Moreover, these lamps were designed *expressly* for use with this size reflector; while the conversion process makes a new mirror merely an appendage of an old lamp by means of gadgets.

We do not imply that the Kneisley can not effect substantial improvement in certain spots where all the elements involved combine to permit successful application of the plan. Such instances are rare, however, and certainly do not justify exploitation of the process on the basis of generally satisfactory results.

Granting the existence of specialized situations wherein conversion will effect improvement, it must be remembered that any old-style l. i. lamp is about ten years old, which means that, judged by modern standards, it is all "shot"—its motor worn, its brushes gone, its gears and arc control something less than satisfactory. On even the most favorable basis, a converted lamp still is only 1 part new and 99 parts old. Its optical system is sadly deficient, and there will be trouble with the trim. Mr. Kneisley cites the Sparks and Warner theatre circuits as having approved his process and made many installations thereof. Which statement prompts the observation that these theatres, after an expenditure of between $60 and $80 per projection room (for two lamps), got just what they paid for—a new mirror.

Conversion processes inevitably follow in the wake of any new equipment development. They are aimed at the smaller houses which, either unable or unwilling to make the necessary expenditure, attempt to "approximate" the results obtained with new equipment in other theatres, probably competing spots. There has never been a lack of equipment people ready to satisfy this demand. The Kneisley process obviously had its inception in the introduction of the Suprex arc—which circumstance forces consideration of not only *quantity* but also *quality* of screen light. Quantity of light has already been covered in the aforementioned article. Let's look into the question of quality.

Lamp manufacturers report a continuing demand for l. i. lamps; but if we were an exhibitor, we wouldn't touch a l. i. lamp with a 10-foot pole—not with a Suprex arc available. Any discussion as to the comparative worth of these two lamps would be futile, so pronounced is the superiority of Suprex arcs over the l. i. arc. The Suprex arc delivers 100% more light than the l. i. arc. Suprex light is white; l. i. light is yellow. There simply is no comparison.

The question boils down, then, to the inability of small theatres to shell out between $600 and $700 for new lamps. Thus they turn to conversion as the only means for effecting improvement. But there exists ample reason to doubt that such a decision is more sound economically than it is technically. Any exhibitor can arrange credit with a supply house; in fact, one manufacturer advertises a "out-of-income" purchase plan. The conversion process costs about $70, and when it is completed the exhibitor still has old lamps and a dirty yellow screen light. This money might well be applied toward the purchase of new lamps, which will deliver improved results and help to stimulate business. We do not pose as an expert on the economic aspects of projection equipment purchasing, but we don't see where an expert opinion is needed to buttress this line of reasoning.

Thus, whether the consideration be one of economics or technical worth, we can not subscribe to the idea of converting l. i. lamps by merely adding a larger mirror. Fair success may attend the application of this process to specialized situations (a problem that we can't work out from afar); but in general the plan does not commend itself to us. Having presented the facts as we see them, the decision is not ours to make.

The Musicians' Campaign Against 'Canned Music'

The progress of the electronic and mechanical arts has contributed mightily to technological unemployment, despite the soothing syrup doled out by industrialists. Sound pictures, particularly, wrought havoc with musicians and stagehands. The AFM has just launched a campaign to "force the return of living musicians to theatres," appropriating $250,000 therefor. We sympathize with the musicians, but we can't go all the way with them.

The musicians emphasize their contempt for the "canned music" of sound pictures. Personally, we consider it pretty good "canned" stuff; in fact, happening to be a symphony music addict, we prefer much sound-picture music to that dispensed by "living musicians." Most of the symphony halls are elaborate barns, acoustically, the results in which have sent us away from many concerts with a definite feeling of frustration. The AFM forgets that in sound-picture recording and reproduction we utilize controls over the sound level and frequency relationship, the results of which are impossible of attainment by even a Toscanni in a hall that is perfectly treated acoustically. We defy anybody, musician or not, to listen to the sound-picture reproduction of, for example, RCA's recording of the musical accompaniment to "The Eternal Road" and say that it is inferior music in any respect, much less that it is "canned" music.

We cite symphony music because we doubt that even the AFM regards the difference in quality between the stuff put out by theatre-pit or dance bands and a recording of the same stuff as a serious threat to our national culture. Incidentally, the AFM does not recognize radio broadcasting as a threat to our culture, despite the fact that the upper frequency limit of radio is about 6,500 cycles. Sound pictures exceed that range by about 2,500 cycles.

The AFM might do a little house-cleaning on its own before assailing sound pictures. A comparatively small number of AFM members are doing practically all the broadcast, sound-picture recording, and electrical transcription work. Maybe the AFM has never heard of the share-the-work plan, which is a great idea to apply to unemployment problems.

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

IN an effort to substitute living musicians and actors for mechanized music and "canned entertainment" (sound pictures) the American Federation of Musicians will spend $250,000 and organize a group of 5,000 members for picket duty before motion picture theatres throughout the U. S. The first shot in this campaign was fired by L. U. 802 in N. Y. City, where all the Broadway theatres on a straight sound-picture policy were picketed constantly.

Picket placards bore some fancy language, stating that musicians were driven from theatres by the "greed of theatre-owners for bigger profits," and that a sound picture is only "canned music," and that the moviegoing public is being "cheated" at present admission levels. If the L. U. 802 campaign succeeds, the AFM will extend the drive. Extensive use of women pickets and canvassers is planned. The AFM drive appears to have the moral support of all AFL affiliates, except I. A., which was conspicuously absent from the list of organizations supporting the musicians, with whom it has a mutual-support pact.

Some years ago the AFM undertook a similar campaign against sound pictures, spending more than $1,000,000 in newspaper and publication advertising in an effort to enlist public support. The campaign was a prize flop. This time the campaign will employ direct action in the form of picketing.

Field Personnel Changes

James Frank, Jr., associated with RCA for many years, will join the staff of International Projector Corp. on Oct. 1.

- -

Will C. Smith, pioneer projectionist and long associated with National Theatre Supply Co., has been transferred from the home office to the N. Y. City branch at 1560 Broadway. His new duties will be to establish closer relations with theatre circuits and meet with theatre owners and projectionists visiting N. Y.

- -

Leslie R. Abbott, of Chicago, has been appointed sales manager of Motiograph, Inc., succeeding Walter Hirschfeld, who resigned after 13 years in this post. Abbott has done projection engineering work in the Middle West for many years and is highly regarded in that territory. Hirschfeld has not announced his future plans.

M. P. Section Transfer

Trade-promotion activities of the U. S. Dept. of Commerce have been transferred from the Specialties Division to the Electrical Division of the department. Foreign sales of American motion picture equipment and rentals for films return about $85,000,000 to the United States annually. Nat Golden, director of the unit since its inception in 1926, will continue in that post. Golden is a member of Cleveland L. U. 160.

Units Balk at Double Reels

The first month of the new double-reel "standard" saw numerous projection groups insistent upon running only single reels. Boston L. U. 182, which led the fight for the single reel in organized ranks, and Chicago are standouts among the localities which, refusing to handle double reels, constitute a large slice of the distribution map.

The Mass. Dept. of Public Safety will hold an open hearing soon, in which both projectionists and distributor representatives will participate, the results of which will determine the reel policy for the State. Chicago's decision banning doubles apparently is final and irrevocable. Neither the Academy nor the Hays office has indicated what action, if any, will be taken to validate doubles as a national standard.

Police Limitation of Pickets Unlawful, N. Y. Judge Rules

Policemen cannot arbitrarily limit the number of labor union pickets before a business establishment, it was held recently by Magistrate Charles Solomon of N. Y. City. Commenting on a case before him relating to the efforts of policemen to reduce pickets in front of a theatre from four to two, the magistrate said:

"The command of a police officer need not necessarily be obeyed. Obedience is due only to his lawful commands. When he transcends his authority there is no legal obligation on the part of civilians to obey him. If the law was otherwise, policemen would be the final arbiters of the rights of citizens. Such a situation would be unthinkable."

Erratum

A typographical error in the editorial note on page 24 of the last (August) issue of I. P., under the heading "A Note Anent K.D. Projector Optical Setup," distorted the meaning of the last sentence therein. The sentence was printed as: "What improvement, if any, has been effected is not known; but in the light of claims made for this setup this clarifying statement seems unwarranted."

The prefix "un" in the last word of this sentence should have been omitted, thus making the word read "warranted," as was intended.

Academy Film Field Tests

A series of comprehensive field tests of the various film preservative processes will be conducted by the Academy of M. P. Arts & Sciences. A test reel containing several 150-ft sections of film, each section treated by one different process, will be taken into each of about 150 theatres and projected from three to six times in each house in order to determine the actual and comparative effects of field service on film treated by the respective processes.

Richardson Testimonials Planned

The American Projection Society, first technical organization in the motion picture industry, will tender a banquet in honor of F. H. Richardson on Saturday, Oct. 24, at the Hotel Pennsylvania, N. Y. City. This will be the first of a series of events to be held within the ensuing week to mark Richardson's 70th birthday anniversary. International Projector Corp. and National Theatre Supply Co. will jointly give a luncheon in honor of Richardson on Tuesday, Oct. 27, and the staff of Quigley Publications will follow suit later in the week. Other activities will be announced later.

Pay Rise Ends RCA Strike

Pay increases of from three to five cents an hour were granted by RCA Mfg. Co. to 9,000 workers in its Camden, N. J., plant in settlement of the recent strike which for a time threatened to assume serious proportions. The strike was conducted by the United Electrical and Radio Workers of America, not an AFL affiliate.

State Groups Favor 2-Men Projection Shifts

The Nebraska Federation of Labor recently adopted three resolutions affecting theatre labor: (1) advocacy of two-men projection shifts for all theatres with more than 600 seats; (2) compulsory complete lavoratory facilities in projection rooms, and (3) the replacement of "canned music" (sound pictures) by living orchestras.

The N. Y. State Federation of Labor approved a two-men shift resolution also.

Professional standard 35 mm. film has 16 frames per foot. 16 mm. film has 40 frames per foot. 8 mm. film has 80 frames per foot.

THE KNEISLEY L.I. LAMP 'CONVERSION' PROCESS

(*Continued from page* 22)

flector, when set back about 4 inches, strikes about the best average.

Practically every low-intensity lamp produced within the last several years has utilized 10¼-inch reflectors with a working speed to match that of the projection lens. On some installations the light therefrom is gratifying; whereas on some other jobs the increase of light is hardly noticeable, for the reasons outlined previously. At least, on some jobs there is not sufficient light increase to make an issue of it, and no manufacturer gives this fact more than casual mention in his advertising.

A lamphouse designed especially for use with these large reflectors is obviously more efficient than a converted old-style lamp, because in the latter jobs at least 25% of the increased mirror area is cut away or shadowed by the internal mechanism of the lamp. A prime reason for shying away from these conversion jobs is the strenuous opposition thereto of projectionists, who, after the novelty of the change has worn off, find that the increased diameter of the reflector takes away considerable of the carbon carriage travel, and in many makes of lamps there is only about 4 inches of carbon left, if that, for a trim.

This conversion process, at its best, is palpably only a makeshift which could never match the efficiency of a new lamp. Some of these conversion jobs undoubtedly will show considerable increase of light; but, considering the field as a whole, the increase effected thereby will vary from considerable in some few instances down to a point where it is hardly noticeable.

Apparently this conversion process has its roots in the wide swath being cut through the projection field by the Suprex-type arc. Granted that such a conversion job would under ideal circumstances effect the maximum percentage of light increase claimed for it, any comparison between even these best results and those obtained with the Suprex arc is futile to a point approaching the ridiculous. With operating costs for both the low-intensity and the Suprex-type arcs practically the same, there is no apparent justification for preferring the yellow light of the former to the white light of the latter.

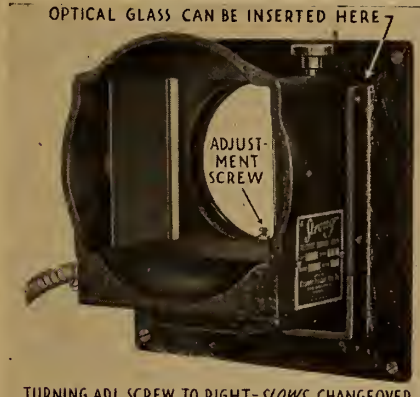
Projectionists will do well to consider this matter in terms of light-pickup angles and light-projected angles and in the matching of lamp optics with projection lens optics, rather than in terms of reflector diameter. After all, a reflector 1 inch in diameter can project as much light as one 10 feet in diameter; it is only such physical dimensions relating to positioning of rear shutters and length of carbon trim which determine the distance of the reflector away from the aperture, which in turn determines the light-angle requirements to be met.

FUNCTION OF MATHEMATICS IN APPLIED SCIENCES

Appended are excerpts from a recent address by John R. Carson, of the Bell Telephone Laboratories, in which is explained the true function of mathematics and the necessity therefor in the applied sciences. Projectionists, having been particularly critical as a group of the increasing use of mathematics in the solution of technical problems, will find much of interest herein.—*Editor.*

THERE are some who are contemptuous as regards the value of mathematics in the applied sciences. Their view is that you put mathematics into the problem and you get the same mathematics out, so that the mathematics contribute nothing. What these critics fail to see that *the function of mathematics is to render explicit relations which are involved and implicit.*

It is true that when we have correctly formulated a problem in words the answer lies in this very formulation, but it is latent and concealed. When we translate the formulation of a problem into mathematics—that is, express its physical relations in terms of symbols and equations—we are merely writing



TURNING ADJ. SCREW TO RIGHT-*SLOWS* CHANGEOVER
TURNING ADJ. SCREW TO LEFT-*SPEEDS* CHANGEOVER

THE STRONG 'SPECIAL'
$60 a Pair

There are more STRONG CHANGE-OVERS

in use now than the combined total of all other makes. There must be a reason for this pronounced preference for STRONG change-overs. Remember this when you install or replace your old change-overs.

The "Special" change-over (shown here) combines STRONG quality with economy and reliability. At $60 a pair, including foot-switches, this quality change-over is within reach of even the smallest theatres. Modernize your equipment now—and insist upon STRONG change-overs. No other kind will give you as efficient, dependable and trouble-free service.

STRONG Change-overs are Available at all Theatre Supply Dealers

ESSANNAY ELECTRIC MFG. CO.

OLDEST AND LARGEST MANUFACTURERS OF ELECTRIC CHANGE-OVERS IN THE WORLD

908 South Wabash Avenue **Chicago, Illinois**

L. D. Strong (member, L. U. 110), *President*

down the problem in shorthand. But having done so we are then in a position to forget the original problem and to solve the equations by the methods of mathematical analysis, which is the greatest mental-labor-saving machine ever invented. Instead of having to keep in mind involved and complicated relations, we have in mathematics a tool that does this work for us, once the problem has been correctly formulated in equations which express the physical relationships.

A Guide to Experiment

In the applied mathematics of physics and of electrotechnics every symbol has a physical significance and every equation expresses in a symbolic term a physical relationship. In pure mathematics this is not the case—in fact, as Eddington remarked, a pure mathematician is never so happy as when he doesn't know what he is talking about. This remark is more that witty; it is really acute. Because the pure mathematician is dealing with abstract relations: the more general and vague his symbols are, the more general are his results.

Fundamentally, then, the function of mathematics in electrotechnical research is to provide a guiding theory to interpret the results of experiment and to suggest future lines of development and research. As a by-product of such mathematical research in communication we now have a substantial body of inventions and patents which owe nothing immediately to the experimentalist.

N. Z. Projectionists Protest Poor Wages, Conditions

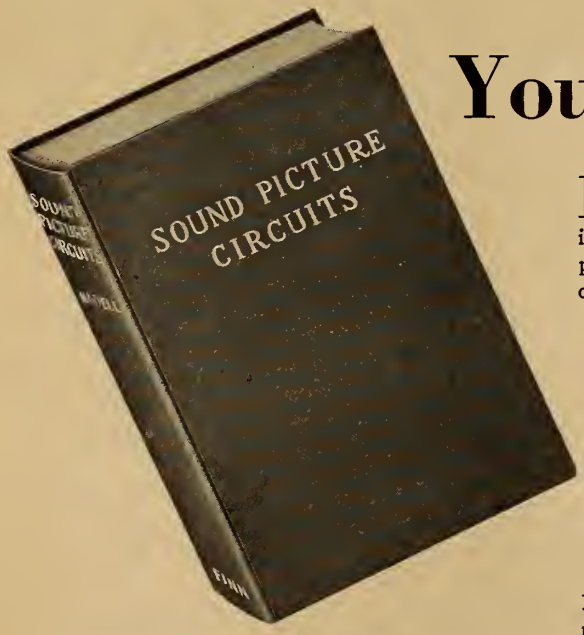
WELLINGTON, N. Z.—Strenuous representations have been made to the Dominion Minister of Labor by projectionists in an effort to effect improvement in wages, working conditions and license requirements. There is much discontent among these workers at present, with ventilation of projection rooms to be made the topic of special representations to the Government, several cases of carbon-dioxide poisoning being alleged.

Projectionists charge that licenses are granted for new theatres without any regard whatsoever for the health of workers therein. The press, trade and general, has exhibited particular interest in the plight of theatre workers, as is indicated by the appended excerpt from one press statement:

"If the alleged complaints of some projectionists regarding the hours they have to work are true, some exhibitors will be shown up in a most unfavorable light. In fact, without doubt, the present Government will take action in no uncertain manner. It is claimed that some operators have to work as many as three sessions without assistance, that they are reprimanded and threatened with dismissal if they require replacements of parts for their machines, and that they are subject to all sorts of bullying tactics by managers. It is also claimed that operators' assistants in some cases have to assist the caretaker and do bill-sticking, all for $10 weekly.

"If only half of what has been reported to the writer is true, there is no doubt that the Minister of Labor will order an investigation into the matter."

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INDUSTRIAL UNIONISM IN THE THEATRICAL FIELD

By *JAMES J. FINN*

WRITING in *The Billboard*[1], widely-read theatrical weekly, Paul Denis uncorks an article entitled "Labor's Newest Headache: How the Industrial Union Fight Affects the Show Business." Denis is extremely capable and knows his way around show business and in and out of union circles; but in this particular article his facts, probably fed to him supposedly right out of the feed-box, are a bit twisted.

First, Joseph N. Weber is cited as "probably the most powerful figure in the theatrical union field." Of course he isn't, despite his status as president of the A. F. of M., vice-president of the A. F. of L. and a member of the latter's executive council. Weber's influence in the theatrical field (legitimate stage and pictures) has been nil since sound pictures slaughtered the musicians, and likely will continue on that level. I. A. unquestionably is the foremost labor organization in the theatrical field since it regained virtually complete dominance of the studios through its 1935 coup.

I. A. Stand Misrepresented

George E. Browne, I. A. president, is described as a "militant and shrewd leader" (which statement no informed person will dispute). Mention is made of how "the I. A. . . . voted with the craft union crowd on the vital question of indorsing industrial unionism" at the last A. F. of L. convention. Denis states that when the I. A. moved against the I.B.E.W. last December, "the I. A. spread rumors that it had the backing of John L. Lewis and the C. I. O., and that it had been guaranteed a large fund to organize the unorganized workers of the theatre." This unqualified statement is red-hot news to the writer, and it is probably news to Browne, also.

Now, it happens that in connection with the I. A.—I.B.E.W. mixup last December, the writer did a few chores as a volunteer press-contact man in behalf of I. A. The story was big enough in itself, of course, but the newspaper boys just couldn't suppress a natural instinct to add still another "angle" to the yarn. So they dragged into the picture the C.I.O. and its leader, John L. Lewis, who at the time was emitting lusty rumbles about industrial unionism.

Browne Denied C. I. O. Link

The newspaper men were right in sensing an affinity between I. A. and industrial unionism, of course, because, despite the I. A. vote at the A. F. of L. convention and the absence of any explicit declaration by I. A. officials, the setup of the I. A. has a distinct industrial-union flavor, which will endure even if the I. A. votes in favor of the A. F. of L. craft unions for the next century.

But, did I. A. spread rumors of Lewis backing and C.I.O. support in the form of a "guaranteed" fund? Just the reverse is true. The hardest task in connection with the aforementioned press-contacting was in seeking to squelch this angle of the story. Formal denials by Browne were issued, and every effort was made to show its utter lack of any basis in fact. Apparently, however, this "angle" still survives.

The writer is not privy to Browne's present relations with either John L. Lewis or the C. I. O., if any, nor does

[1] Aug. 29, 1936, issue, p. 34.

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he know Browne's attitude on craft vs. industrial unionism inside or outside of the theatrical field; but nothing has come to his attention recently to suggest that Browne's attitude on this question has undergone any material change since last December.

Denis mourns the fact that Browne repeatedly refused his invitation to comment on the industrial union situation. Browne's declination does not surprise the writer, who has pointed out previously that Browne need not have *any* viewpoint on this matter, since he is operating as I. A. president in what is practically an organizational vacuo, so well in hand are I. A. affairs at the moment and so well-defined are its jurisdictional rights and its future course.

The most penetrating comment in the Denis article is supplied by William Bledsoe, research secretary of the Screen Actors Guild, who is quoted as saying, in part:

"The picture industry is still more dependent upon skilled artists and technicians than machines. For that reason pure industrial unionism at the present time would be premature. However, I strongly favor a close cooperation of all the various craft unions involved and believe that some kind of a working mechanism should be established—possibly a federation of motion picture unions similar to those in the printing industry and building trades.

"As industry becomes more and more mechanized and the importance of the skilled craftsmen diminishes it is only logical that vertical unionism will tend to replace craft unionism."

The consensus of opinion on industrial unionism within the theatrical field among those union leaders polled by Mr. Denis is an emphatic "No." This result was to be expected, considering what industrial unionism would do in the way of abolishing organization jobs.

Projection Problems Feature S.M.P.E. Meet Program

REPRODUCTION problems will be accorded major attention at the convention of the Society of Motion Picture Engineers to be held in Rochester, N. Y., Oct. 12-15, inclusive. Supplementing the attractive papers program and equipment demonstrations that have been arranged will be visits to the plants of both Eastman Kodak and Bausch & Lomb, the products of which are known wherever motion pictures are shown.

The long-awaited details of the Eastman system of color photography will be presented by Dr. C. E. K. Mees, director of research for Eastman Kodak Co., whose lecture will be embellished by demonstrations. Another feature of the sessions will be a symposium on projector-testing devices, to be participated in by outstanding technicians. Several other papers having direct bearing on the projection process will be presented also.

Announcement of the election of officers will be made at the opening session. Presentation of the SMPE *Journal* and the Progress Medal award will be made at the semi-annual banquet scheduled for Wednesday, Oct. 14.

Of particular interest to projectionists and others interested in theatre reproduction problems is the appended partial list of papers scheduled:

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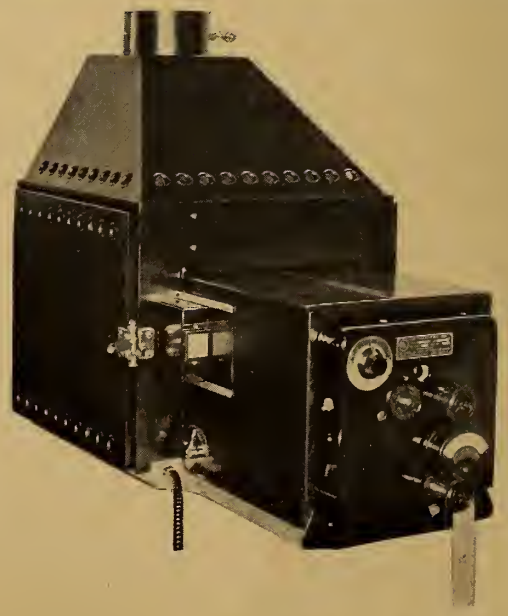
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Report of the Sound Committee.

"A Review of the Quest for Constant Speed," E. W. Kellogg, RCA.

"A New Type of Peak Reading Volume Indicator," F. L. Hopper, ERPI.

"A Neon-Type Volume Indicator," S. Read, Jr., RCA.

"A Neon Tube Oscilloscope as a Utility Instrument for the Projection Room," T. P. Hover, Ohio Theatre, Lima, Ohio.

"The Schwarzkopf Method of Identifying Criminals," J. Frank, Jr., International Projector Corp.

Demonstration Film Showing Several Applications of Photography with Polarized Light (*Courtesy of American Society of Cinematographers, Inc., Hollywood, Calif.*)

"Color Photography" (with demonstrations and motion pictures), C. E. K. Mees, Eastman Kodak Co.

"The Kodak Research Laboratories," C. E. Kenneth Mees, Eastman Kodak Co.

"Manufacture of Motion Picture Film," E. K. Carver, Eastman Kodak Co.

"The Care of Slide-films and Motion Picture Film," C. G. Weber and J. R. Hill, National Bureau of Standards, Washington, D. C.

"Fire Protection in the Motion Picture Industry," H. Anderson, Paramount Pictures.

"The Projection of Lenticular Color Films," J. G. Capstaff, O. E. Miller and L. S. Wilder, Eastman Kodak Co.

"The Art of Lighting," G. Folsey, Hollywood, Calif.

"Effect of Lens Aberrations Upon Image Quality," W. B. Rayton, Bausch & Lomb Optical Co.

"Mercury Arcs of Increased Brightness and Efficiency," L. J. Buttolph, General Electric Vapor Lamp Co.

Report of the Studio Lighting Committee.

"Trick and Process Cinematography," J. A. Norling, Loucks & Norling Studios.

"A Third-Dimension Effect in Animated Cartoons," J. E. Burks, Fleischer Studios.

"Continuous Projection as Applied to Film-Viewing Machines," J. L. Spence, Akeley Camera, Inc.

"New Recording Equipment" and "An Improved Reel-End Alarm," D. Canady, Canady Sound Appliance Co.

"Three-Wire, Direct-Current Supply for Projector Arcs," C. C. Dash, Hertner Electric Co.

"A Demonstration Triode Tube," F. E. Eldridge and H. F. Dart, Westinghouse Lamp Co.

"New Theatre Reproducing Equipment," J. S. Pesce, RCA.

Report of the Standards Committee.

NEW W. E. 'MIRRORPHONIC' THEATRE SOUND SYSTEM

(*Continued from page* 14)

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tion room, not only as a means of consolidating control of the entire sound system in one place but also to preclude the possibility of any arguments developing between themselves and stagehands as to jurisdictional rights.

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Modernization With Mirrorphonic

Projectionists should be interested in the merchandising as well as the technical aspects of the Mirrorphonic system, so that they may be able to render competent advice to either owners or managers by presenting the whole story. Thus this appendage.

The term "Mirrorphonic" denotes a complete sound-picture reproducing system; but modernization of existing equipments may be accomplished by the installation of *individual* Mirrorphonic units from time to time, depending upon the preference of the customer—or, stated bluntly, upon his ability to pay. Table A of the preceding article is a concise representation of the various Mirrorphonic installations. Any combination of equipment mentioned therein is a Mirrorphonic system; while the lack of any given unit means that Mirrorphonic results are not obtainable.

Theatres that are still using the old 8-B and 10-A amplifiers, with contemporary speakers and other equipment, require a complete new Mirrorphonic installation (apart from the wiring run from amplifiers to speakers, of course). The modernization job need not be done at one fell swoop; any Mirrorphonic unit—soundhead, amplifier, speaker, etc. —could be installed first. The soundhead is the natural choice for a starter, other units being added subsequently.

Many theatres now have the Erpi Wide Range system, installations of which were made as recently as two months ago. Some of these houses have the new cellular speakers, or the new amplifiers, or some unit of the Mirrorphonic system. Reference to Table A, mentioned previously, will enable a quick decision as to what units are needed to bring a given system up to the Mirrorphonic standard. Here again the unit installation plan may be adopted.

The importance of this presentation of Mirrorphonic data (particularly Table A) to the projectionist can not be overemphasized. As the only group in the theatre field that knows the complete story—technically and otherwise—projectionists are in a position to render a valuable service to their employers and thus add to their prestige. If they are not asked about this development, they should *volunteer* the information.

I. P. has no more important function than to disseminate information of this character, which not only contributes substantially to improved reproduction in the theatre but also permits the craft to assume its rightful place in the development of the art.

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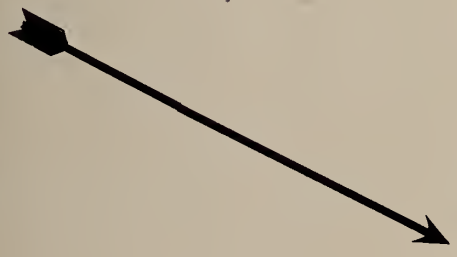
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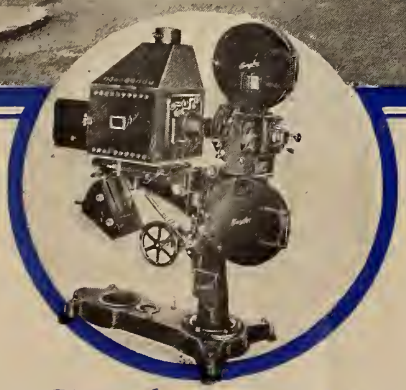
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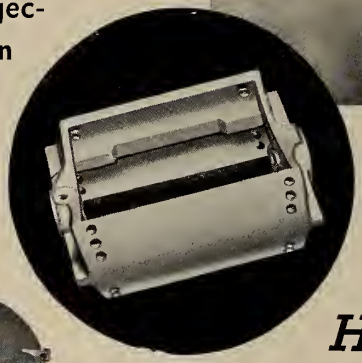
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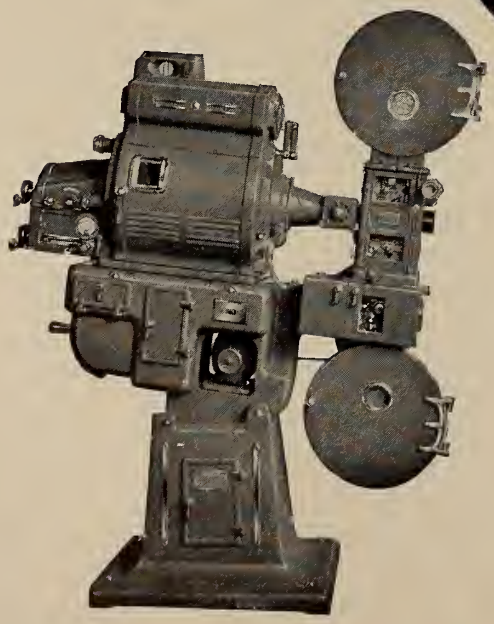
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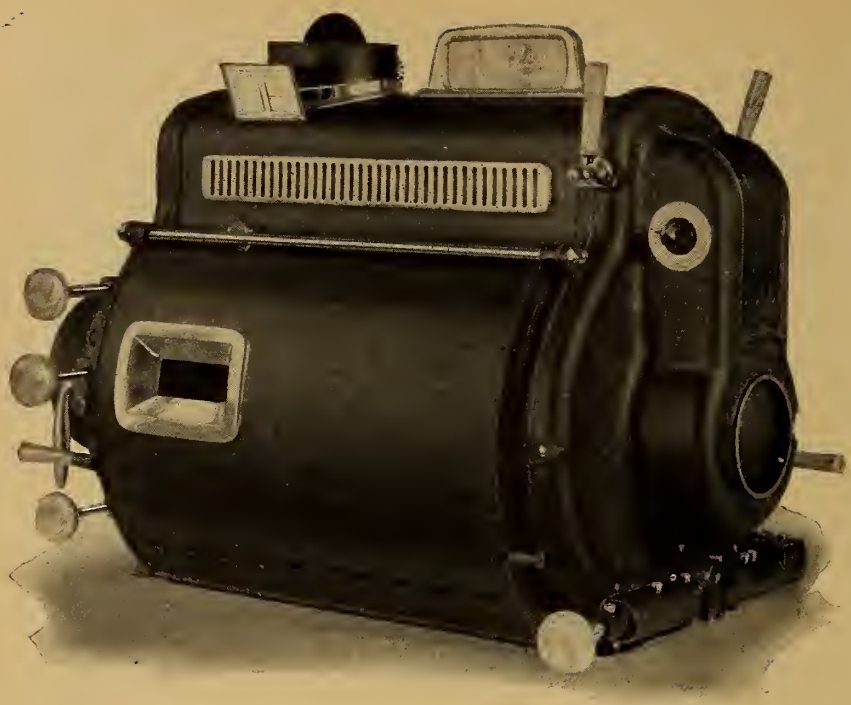
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Edited by James J. Finn

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Index and Monthly Chat 5

Sound Projection Problems: Past, Present and Future 7
A. C. SCHROEDER

RCA Push-Pull Set-up at I. A. Kansas City Meet 11

Step-By-Step Analysis of Theatre Sound Reproducing Equipment, XXI 14
WILLIAM STRATHY

Reproduction Problems, Color Feature S.M.P.E. Meeting ... 17
JAMES J. FINN

Troubles and Trouble-Shooting in Modern Amplifiers 21
AARON NADELL

An Outstanding Example of Fine Craft Advertising 22

High-Intensity Arc Aperture Temperatures at Various Running Times 24
A. C. HARDY

Notes From the Supply Field .. 25

News of the Month 26

News Notes

Technical Hints

Miscellaneous Items

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MONTHLY CHAT

CHICAGO having okayed the use of double reels, there remains not even a trace of organization opposition to this new projection standard—except in Boston, where the final decision has not yet been forthcoming. Boston looked good in its role of a modern Horatius, and it looked even better when it agreed to abide by the final ruling of the State authorities.

HOLLYWOOD is falling all over itself in a mad rush to produce color film—the while numerous defects in the production and showing of black-and-white prints demand correction. It's a great industry, this; reminiscent of a man dressing himself by first donning his overcoat. The celebrated Cecil B. De Mille stated recently that 50% of U. S. theatres have decidedly inferior projection which nullifies the best production efforts. The answer to which is apparently to add another 50% error in the form of color and make it a perfect score.

THE latest all-color motion picture, "Ramona," increased rather than diminished our preference for a well-lighted black-and-white job. If this be a sample of "good" color, may we be shielded permanently from such pictures.

CORRESPONDENCE schools continue to flood the country with literature bearing on the glories of becoming a projectionist—all the reputed glamour of Hollywood being dangled before the suckers' eyes. Some choice samples of such promotion work will appear in an early issue.

PROJECTIONISTS persistently harp on the necessity for "simplifying" the editorial content of this publication. Extremely far apart are the high and low levels of projectionist education and native intelligence, thus complicating our job. Invitations to use I. P. service facilities appear frequently in appendages to articles containing terms the intelligibility of which occasions editorial concern.

The time to utilize I. P. service facilities is when you spot herein anything that is not entirely understandable. Jump up immediately; and we'll come right back at you in the following issue.

THOSE generator fellers are the greatest conversationalists extant, rambling on for hours about how their product is as economical and more efficient and dependable than any rectifier ever built. These are just pleasant verbal confidences between us girls, you know, because the generator people are much too modest to let the craft in on the secret through advertising.

WITH this issue I. P. is five years old—*sans* special issues, or banquets or a raft of congratulatory messages in type. This unselfish devotion to duty will be our undoing.



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INTERNATIONAL PROJECTIONIST

VOLUME XI NUMBER 4

OCTOBER 1936

SOUND PROJECTION PROBLEMS: PAST, PRESENT AND FUTURE

By *A. C. SCHROEDER*

MEMBER, PROJECTIONIST LOCAL UNION 150, LOS ANGELES, CALIFORNIA

PROBABLY the first effort to improve sound-picture reproduction was the scratch filter used with the old records, followed by the "juggling" of the grid leaks, to bring up the 6000-cycle signal on the film. Exciting lamps were burned at 6-point something or other, for the same reason. New optical systems helped the cause, too. Juggling the grid leaks stopped for a while; instead the horns were juggled by learned men who "came out of the East."

Remember the storage B batteries? Then we had high-voltage generators and, later on, rectifiers, so-called power units. This may not have assured better quality, but who would not gladly give up umpty-steen batteries for one power unit, quality or no quality?

Later we were afflicted with "equalizers". This probably was not prevalent throughout the country; but in this locality (California) the studios take pretty much of a hand in things, and when pictures went out on a preview, or some of the big pictures opened, the studio got busy with equalizers—only when the recording required it.

I remember one happening incident to the opening of one of RKO's big pictures. Carl Dreher† walked into the projection room during the intermission and said:

"I'm Mr. Dreher. Who's in charge here?" It's funny how quiet a projection room can be. Nobody spoke for a few seconds. Finally the chief said "I am."

"You're losing all your fundamentals," snapped Mr. Dreher.

"Huh," retorted the chief; "that's the first time I ever heard anybody holler about that. They always kick about losing the highs." Which observation was the whole truth. However, the fundamentals were "it" this time, so an equalizer was built and installed the next day, together with a couple of ten-cent store switches. We put the equalizer into the circuit and out again twice during each performance.

"Dummy" Sound Projectors

Then there were "dummies." Don't laugh; this is serious business. A dummy is a machine interlocked with a regular projection machine, and on it is run a film with no picture on it, only sound. A switching arrangement is provided so that the sound can be taken either from the regular machine or from the dummy. The latter may be a Simplex without the intermittent, or it may be especially built, in which case it is a casting with a feed sprocket, a sound sprocket, and sometimes a hold-back sprocket.

The dummies treated the sound track better than our ordinary heads did. There was no heat from the arc, and no intermittent to jerk and strain the sprocket holes. The interlocking occasioned all the "fun." Some were mechanically driven either from the regular head or from the motor shaft to which the record turntable was normally connected. The most flexible arrangement was where the dummies were electrically interlocked, using Selsyn motors and distributors.

Selsyn motors are three-phase, slip-ring motors. The slip rings of all motors to be interlocked are connected together; the rotors are paralleled. The stators are connected to the three-phase line. Now, if you reflect a bit, you will remember that a slip-ring motor will not

† Director of Sound Recording for Radio Pictures; since resigned.

run if there is no external connection across the slip rings. With a "short" across the slip rings the motor runs at its greatest speed; it has the most torque. Replacing the "short" by a variable resistance causes the motor to speed up or slow down, in accordance with the value of the resistance. When two or more of these motors are so connected, and with neither a resistance nor a "short" across the slip rings, the rotors take a certain position. If one be turned one-half revolution, the others also turn exactly one-half revolution. If one be turned and the others held, upon being released they again assume the same position with respect to each other, although they may all be in a different position with respect to the stators than they were at the start.

When turning at 1200 r.p.m., they still keep in step. One makes one revolution each time the other does. Should one or the other lag a bit, rotor currents are set up and they are pulled back into synchronism. It is through this characteristic that the machine and the dummy are kept in step, even when situated in different buildings.

The motors supply no torque of their own, in the normally accepted sense. This is where the distributor comes in which may be one of the motors ordinarily used with the control box, but is often of greater power. This motor drives a Selsyn motor, the rotor of which is wired to the rotors on the machines and the dummies, and these rotors "follow" the rotor driven by the distributor. There we have it, however lengthy and involved.

There are several peculiarities about this arrangement. Two machines to be driven by the ordinary motor, the distributor, is a pretty fair load, so a larger one is used. In the studios, however, there are sometimes as many as ten or twelve motors interlocked, thus even the large motor would be overloaded. To overcome this difficulty, and to help the pick-up, resistors are hooked across each phase of the rotor circuit. One can readily see that if resistors are connected across one rotor, they will also be across all the others, all being connected.

Practical Application Unsatisfactory

These resistors, as mentioned previously, give the motors a certain amount of torque, tending to make them run. The resistors being sufficiently large, this tendency is not enough to carry the entire load; power being necessary, the distributor motor has to pull fairly well. Thus the distributor has actual control of the speed, and is itself under the regulation of the control box.

That is how it *should* work. The normal of 1200 r.p.m. is not far from 1440 r.p.m., which would be the synchronous speed on 50 cycles. Sometimes the Selsyn motors get the upper hand as 1200 is approached, and the whole thing runs away—that is, it goes up to 1440 r.p.m. Well, couldn't one open the switch a second so that the motors all dropped below 1200 r.p.m. and then close the switch again and continue on serenely? Not at all! During all of this the machines have gotten out of "sync." Remember? And then we had to stop, re-thread, and start all over again. Of course, sometimes they didn't get out of "sync," but not often. The slightest jar on one of the motor flywheels, or anything that caused one of the rotors to "slip a phase," would be enough to cause them to run away.

Later the dummies were connected directly to the head, mechanically, and fastened in front. The picture film left the take-up sprocket, then ran over several rollers and out toward the front of the machine into a take-up magazine on the dummy head. The sound track was taken from a reel in front of the dummy take-up reel, *located on the same spindle with the take-up*, and then went to the Simplex head, going over and under several rollers, and then down through the sound head and the regular take-up.

Thus only the magazine, a double sprocket and some rollers were needed for the dummy. Of course, there were a couple of gears taking the drive from the large Simplex gear. If the shutter were in front of the lens, it had to be removed, as an additional shutter shaft came with the dummy outfit, which was driven by a chain.

A number of variations of this set-up all were more or less along these lines.

The 'Split-Film' Terror

Came the split film! What, you've never heard of this demoniacal contraption? It supplies more headaches than the electrically-interlocked dummies ever could. But it did save the studio a lot of dough. This is how it works: An ordinary 35 mm. film is recorded in the usual manner; then the film is reversed and another track is put on the opposite side, like a serviceman's test reel. The film is then split along the center, giving two strips each about 17 mm. wide and each having a sound track and one row of sprocket holes. This cuts the film cost in half.

It comes on narrow reels just wide enough for the film. Guide rollers are installed with a flange just wide enough for the film, and it runs on one row of sprocket teeth. Spacers are used to line up the narrow reels. As the dummy take-up reel is behind the feed-reel, one of them must be out of line with the sprockets in the head; so to induce the film to run onto the take-up reel it is given what I would call a spiral loop. The film leaves one sprocket in the dummy, makes a complete circle in air and returns to another sprocket on the same shaft as the first sprocket, but mounted beside it. I hope you understand this, as it is really very simple—*except when it doesn't work right!* They say that if everything is right, it gives no trouble. I agree with them. But, just consider the possibilities of error here. Split film is no longer used in theatres, but the studios still use it.

All this time the studios were pushing ahead on recording. The frequency range was being extended and much effort was expended on reducing distortion. Noiseless recording was introduced, which eliminated hiss during silent parts or where the sound was at a comparatively low level.

Attention was soon directed to the projector film-travel path. A new type of gate was brought out, intended to reduce "gate rasp." Rotary stabilizers were developed, then more new gates; and just recently we have had ultra-violet recording, new horn systems and great increases in power output.

Unique Early-Day Setup

Speaking of increases in power recalls the "Hell's Angels" set-up and its accompanying headaches. Our regular set was an 8-B and a 10-A, which had already been changed to allow overloading the 10-A. When the 10-A overloads, the plate current varies, causing a *varying* voltage-drop in the 6000-A rectifier. The 6000-A also supplies plate current for the 8-B, thus the plate voltages on the 8-B varied as the 10-A overloaded. This occasioned extreme distortion. The 10-A overload was within allowable limits; but when the 8-B plate current was modulated, so to speak, by this overload, the result was terrible. To overcome this we substituted B batteries for the plate supply on the first stage in the 8-B amplifier. This helped so much that we were able to get more power out of the system.

Returning to the additional equipment for "Hell's Angels," in the line of amplifiers there were another 8-B, three 42's and six 43 amplifiers. I forget the exact hook-up, but I believe that the second 8-B fed the three 42 amplifiers, each of which fed two 43's.

Ahead of each 42 was a variable attenuator to adjust the gain. These three attenuators were connected mechanically, one control moving all three, thus keeping the gain of the 42's and 43's balanced. As the big aerial scenes came on the volume on the additional amplifiers was gradually advanced from zero to maximum. There were twenty-four 555W's on the stage, and we "shot"

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PANCHROMATIC NEGATIVE

plenty of them during the picture's run.

Dummies were also used, in addition to records which were put on the turntable for every reel, and the needle started in the groove just as though disc were to be used. This was for standby in case the dummies ran away. When this happened, the machine switch was opened long enough for the speed of the machine to fall to about normal, the sound was switched from the dummy to the record, and the interlock switch for the dummy was opened. Yes, it happened, and the records saved the day.

Another unusual hook-up was made for this picture. We had three dummies, and we arranged two of them so that we could take the sound from both of them at the same time and thus feed the double signal to the amplifiers. This was never used, except a couple days before the opening, when we checked it. It was finally decided to dub the sound onto one track, thus permitting the use of only one dummy.

This was a very elaborate set-up; yet at the present time it is possible to obtain nearly as much power from two modern amplifiers, one voltage amplifier and one power amplifier. During the run of "San Francisco" we had one 86 and two 87's which gave us about a third again as much as the "Hell's Angels" set-up did. At present the Wilshire Theatre here is using one 86 and three 87's, having an output of 150 watts. Instead of placing the dividing network after the power amplifiers, it is placed between the voltage amplifier and the 87's. The high frequencies are taken from the network and go to one 87, the lows going to the remaining 87's. This gives the low frequencies twice as much power as the highs, which do not need all this power in order to reproduce them properly.

Increases of power have been keeping pace with the new horn systems, and results have been very pleasing when the recording was right. Often the recording is deficient, which is an intolerable condition. We have heard some very good sound; yet there is an awful lot of it that is only junk.

One wonders what form the next advances in sound will take. Possibly push-pull recording and reproduction, and maybe the use of polarized light therefor. I have heard that some recordings have gone through on a push-pull track up to the final negative, where it must of necessity be put on in the conventional manner. If and when this becomes a reality, it will mean more dough that the exhibitor must cough up. It may not be so painful, however, as the RCA heads I saw were so arranged that either type of track could be reproduced by merely flipping a switch. The arrangement was quite simple and should not prove so very expensive.

RCA PUSH-PULL SETUP AT K. C. MEET OF I. A. DESCRIBED

Delegates to the recent I. A. Convention in Kansas City exhibited keen interest in the demonstration of RCA ultra-violet recording and push-pull reproduction. Since then numerous requests have been received by I. P. for detailed information relative to the set-up used. This data is appended hereto, and provides an interesting contrast with existing Photophone equipment. The novel optical system employed by RCA for push-pull reproduction was described in detail in I. P. for July, 1936, p. 15.—*Editor.*

THE RCA Photophone sound reproducing equipment employed for the ultra-violet demonstration at the I.A.T.S.E. convention in Kansas City is identical to the regular theatre equipment, except that a film phonograph device was used instead of a complete picture projector. This article will, therefore, describe a regular de luxe theatre equipment as is now available. A sound reproducing system consists of:

Two soundhead attachments
Main amplifier equipment with change-over equipment
Monitoring amplifier and loudspeaker
Power supply equipment
Stage loudspeakers

The necessity for imparting an intermittent motion to the film for proper projection of the picture at a point in the film path only a few inches ahead of the sound track scanning position, makes the problem of achieving constant speed at the scanning position very difficult. Up to the present time the Rotary Stabilizer is the only satisfactory device which permits constant film motion.

Rotary Stabilizer Data

This arrangement consists of a revolving drum gate at the point where the sound track is scanned on a free shaft. On the other end of this shaft is located a hollow cylindrical case. A massive disc, free to rotate on a ball bearing, is placed inside this case with only several hundredths of an inch clearance. The rest of the case is filled with a special oil and then sealed.

When the film is pulled down by the sprockets below the gate, it sets the drum in motion causing the case at the other end of the shaft to rotate. The free mass inside the case is likewise set in motion through the viscosity of the oil. Any irregularities in speed on the part of the film are filtered out by the oil acting as a cushion, proper speed being resumed immediately due to the momentum of the freely rotating mass.

This device acts much more efficiently than does a flywheel and also acts directly at the scanning point rather than at the constant speed sprocket, in which event sprocket tooth chatter would cause distortion. Two driven sprockets between the revolving drum gate and the take-up film magazine properly spaced insure the effectiveness of the Rotary Stabilizer, eliminating all uneven film motion.

All rotating shafts employ ball bearings minimizing friction on the sprockets. A motor mounted on the front and directly coupled to the drive shaft is employed. Both the motor and all of the sound parts are cushioned from the main casting to further eliminate distortion due to vibration.

New Optical System

A constant source of light, carefully shielded from the film compartment, is sharply focussed by a hermetically-sealed optical system as an image approximately 0.1 inches wide and 0.001 inches high on the surface of the film on the revolving drum gate. The use of a drum gate and suitable film path insures the film remaining in the proper focal plane. The sound track portion of the film overhangs the hollow drum so that this light passes through the film. The light emanating from the other side of the film consists of varying light waves.

From a standard sound track one beam of light waves is created; from a push-pull sound track two beams of light waves are created, each of which is directed to the cathode of a photo-electric cell where they are converted to proportional electrical waves. Where a push-pull sound track is reproduced, a toggle switch is mounted in the film compartment, which in one position connects one cathode of the photo-electric cell to the transformer for direct connection to the amplifier, and in the other position connects both cathodes with proper phase relationship to the transformer. Thus, either standard or push-pull recording may be easily reproduced simply by throwing the switch.

The use of a revolving drum gate also eliminates the removal of wax or emulsion from the film, which is caused by other types of gates and often interferes with the reproduced sound.

Main Amplifier Equipment

The sound change-over is accomplished by a switch in a box mounted on the wall in front of each projector. The switches, mechanically-coupled by a rod, simultaneously change-over the output of each soundhead to the amplifier input and the power supply to the exciter lamp. In the same box is located a

potentiometer which permits a plus or minus 10 db. control of the volume to maintain constant output from the stage speakers for varying recording levels. One of the boxes also contains p.e. cell balancing potentiometers.

The electrical waves from the p.e. cell are directed through a transformer to the main amplifier. The main amplifier equipment consists of rack-mounted units. The voltage amplifier is of exceptionally high gain and includes a volume control provided with 40—2½ db. steps. The power amplifier permits an undistorted output of 40 watts. The use of separate voltage and power amplifier units permits the former to overdrive the latter, if absolutely necessary, without appreciable distortion.

In case of an emergency outage of the power amplifier, operation can be temporarily continued on the voltage amplifier alone. If there are, in the future, any marked improvements in recording methods necessitating either extension of the frequency range or increased power output, units can be either added to or substituted for the present ones most economically.

Each unit is all a.c.-operated and is completely self-contained with its own power supply equipment. The mechanical design of the units has reached a new level of perfection. All of the power equipment has been mounted on the rear panel, while the parts comprising the amplifier circuits are mounted on a hinged shelf, which protrudes in front of the rack.

The hinged-shelf feature permits easy access to all parts without the necessity for removing the unit from the rack. It also permits easy removal of the amplifier circuit portion alone if necessary. Capacitors are sectionalized and separately fused, which means that the failure of any one section will not cause a sound outage but will merely cause slightly increased hum. The failure of the fuse can be easily determined by the projectionist so that prompt arrangements can be made for servicing the unit.

These units also include Neon indicator lamps in the plate circuits of the tubes to more easily determine the cause for failure of operation. The units are removable from the front of the rack, simplifying servicing and permitting location of the rack against, or actually in, a wall where necessary. Perforated panels are employed in front of amplifier tubes, permitting quick inspection and replacement if necessary. A two-position switch is mounted at the top of the rack for turning on the power to the units. Standard Radiotrons are used throughout. Provision is made for minor adjustment of the frequency response characteristic to permit satisfactory reproduction for the type of recordings presented under the particular auditorium acoustic conditions.

A remote volume control device is available at an additional cost. Remote push buttons are provided for location at each projector station and in the auditorium.

A small a.c.-operated amplifier in a wall-mounting box with volume control is furnished for operating a permanent-field dynamic cone speaker unit on a short metal directional baffle for projection room monitoring purposes. This makes possible adequate monitoring without using up any power to the stage speakers.

Power Supply Equipment

It is necessary to supply adequately filtered d.c. for operation of the exciter lamps and for excitation of the speaker fields. The most economic arrangement provides for furnishing two power supply units of the tube rectifier type. One of these units furnishes power for one exciter lamp and excitation to not more than five speaker fields. A relay in the unit actuated by the sound change-over switch causes the proper exciter lamp to be lighted. Where six speaker units are used, as generally recommended, a second power supply unit for furnishing excitations to two speaker units is also supplied. This allows the four low-frequency speaker units to be excited by the large unit, and the two high-frequency units by the small.

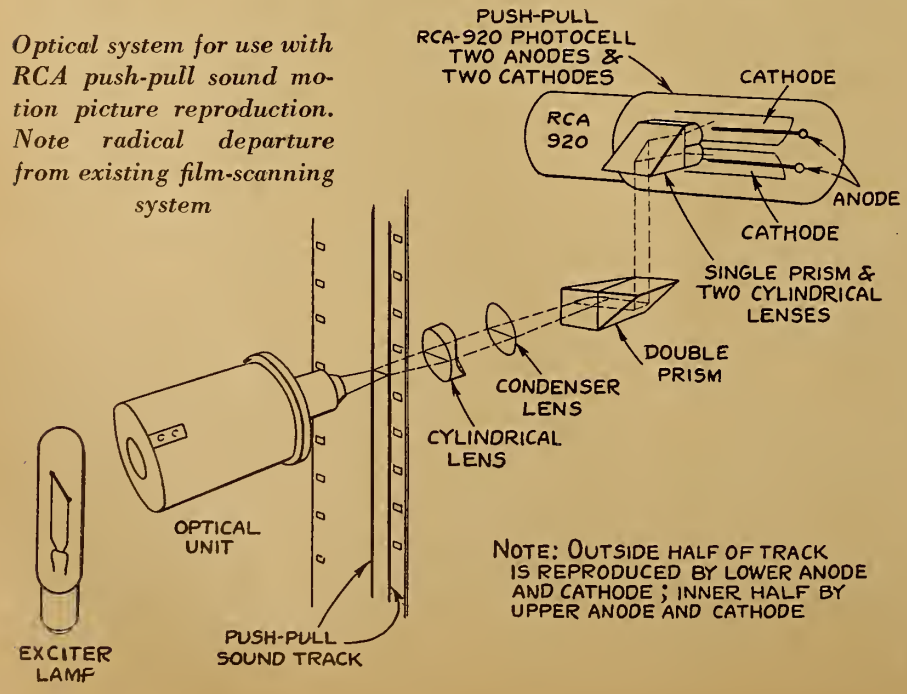
At a slightly increased cost, two of the large units can be supplied, in which case one is used to furnish all speaker field excitation and the other to constantly burn both exciter lamps. The relay is then not used. This minimizes the hazard of sound outage. Both power supply units are dependably built for wall mounting.

RCA de luxe loudspeakers consist of a two-way combination. The high-frequency horn is of the cellular type and employs two units. Temporary operation is possible with only one unit. This is the only type of speaker that will distribute all of the high frequencies uniformly over the entire seating area. Four different sizes with respect to horizontal maximum distribution are available in order that reflection from the walls may be minimized. Two low-frequency loudspeakers are recommended, each consisting of a folded directional baffle with two 12″ dynamic cone speaker units.

A flat baffle frame is furnished for mounting around these speakers. A network system is supplied to properly match the speaker system to the amplifier output and to distribute those frequencies from 40 to 250-300 cycles per second to the low-frequency speakers, and those from 250-300 to 10,000 cycles per second to the high-frequency speaker.

This system of loudspeakers is the most efficient and of the greatest power handling capacity available. Its overall depth of 40 inches requires a minimum of space behind the sound screen.

A spare parts cabinet, a complete set of tubes with spares, and some emergency replacement parts are furnished as part of the equipment.



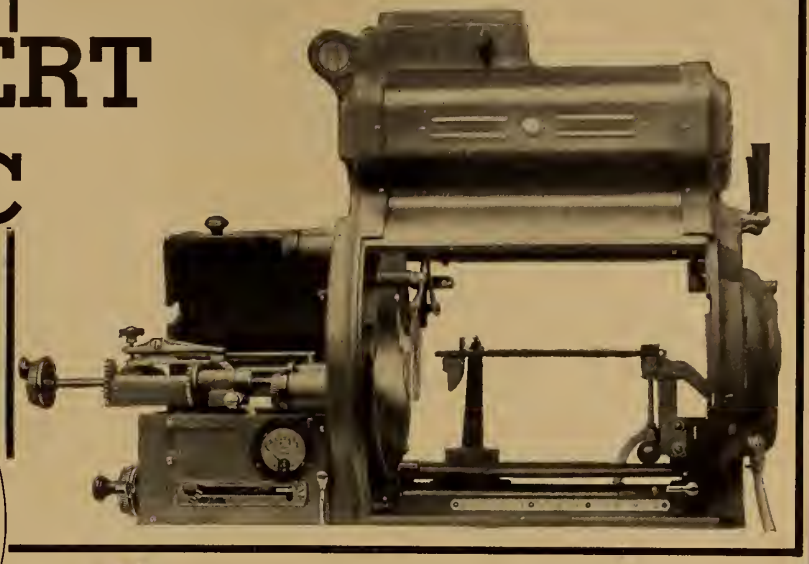
Optical system for use with RCA push-pull sound motion picture reproduction. Note radical departure from existing film-scanning system

Suprex carbons are notorious pitting agents. Much progress toward minimizing this defect has been made since the introduction of the Suprex carbon, and the future undoubtedly will see further improvement along this line. Whatever the ultimate outcome of such endeavor, there exists at present no metal mirror which from the standpoint of cost, efficiency and uniformity can compete with glass reflectors.

I. P. Readers Please Note

The N. Y. Public Library, 5th Ave. and 42nd St., N. Y. City, is particularly anxious to obtain a copy of I. P. for July, 1936, to complete its file of this publication. Receipt of this issue from some I. P. reader who has no further use for it will be greatly appreciated by the Library.

BRENKERT ENARC





FLAME SHIELD CONSTRUCTION

Brenkert Enarc is equipped with a unique and exclusive type of flame shield. The ruggedly constructed closing blades are made of nickel alloy to withstand high arc temperature without warping, binding or corroding. When the shield is opened the blades move to the side of the housing out of range of the ascending arc ash. The swivel bearings are large diameter, generous length and located at the sides of the reflector where they are protected from arc ash and heat. This superb construction results in trouble-free and efficient flame shield operation at all times.

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Step-By-Step Analysis of Theatre Sound Reproducing Equipment

By *WILLIAM STRATHY*
WHOLESALE RADIO SERVICE COMPANY, INC.

XXI. Lafayette 410-A Theatre Amplifier

THIS amplifier circuit reflects advanced design, including phase inversion, use of bias cells and other details never until very recently found in sound-picture amplifiers. It affords 15 watts output from photo-cell input. The amplifier weighs less than fifty pounds, its external dimensions being 6¾″ by 8½″ by 16¾″. For portable operation the amplifier and two matched speakers fit into a carrying case about the size of a rather large over-night bag.

In addition to their primary function of amplification, the circuits supply a.c. exciter lamp power, p.e. cell potential, and field excitation for two speakers.

Line power enters Fig. 1 at the arrowheads shown at the bottom just left of center. The lower a.c. wire runs right and then up to the bottom right-hand terminal of the socket marked "SP'K'R." A dotted line shows that when the plug is in place a jumper on the plug connects that terminal to the left-side terminal. When the plug is removed, however, the a.c. line is opened at this socket, and no part of the circuit is operative. Following left from the left-side terminal, the line runs through a switch and then past a junction point to a fuse; through the fuse and the primary of the power transformer, and left and down to the other a.c. terminal.

Note that there are three fuse clips instead of two, and two fuse positions. In the position drawn, the fuse is set for relatively high line voltage, but it can also be placed between the central and lower clips, as shown, to maintain full volume when low line voltage is encountered. The switch between the fuse and the "SP'K'R" socket is, of course, the main on-off switch controlling a.c. power when the plug is in place.

Returning to the lower a.c. input arrow, retrace as before as far as the switch, but just to the right of the fuse turn down and follow left, up, left and down to the primary of another power transformer; and through that winding and right and down to the other side of the a.c. line. This transformer controls the exciter lamp supply through the two five-prong sockets just below it.

The Exciter Lamp Circuits

The drawing here is slightly complicated by the fact that 5-prong sockets are used, although only 3 prongs actually function. In both sockets, the bottom prongs are jumped to the corresponding side prongs. The solid lines indicate that these jumpers are not (as in the speaker socket) located in the plugs, but in the sockets themselves.

The right-hand side of the transformer secondary terminates in a switch connecting the exciter supply to the top terminal of either of the sockets. This switch mounts on the amplifier panel and has a large handle easily gripped. It is thrown to effect sound changeover by switching the exciter lamp current.

Tracing left from the switch blade along the transformer secondary, there are two taps affording two different exciter lamp voltages. From the extreme left of the secondary trace down and then to the left-hand bottom prongs of both jacks. When the plugs are so wired that their corresponding prongs are operative, the exciter lamp potential is 10 volts. The other tap of the transformer secondary is wired to the right-hand terminals of the sockets, and when the lines running to the projectors are soldered to the corresponding terminals of the plugs, the exciter lamp supply is 8.5 volts. The change-over switch is, of course, located in the common return to the right-hand end of the secondary. and equally operative at either voltage.

Returning now to the amplifier power transformer, note that there are three secondaries, of which the right-hand winding lights the filament of the 83V rectifier tube, and has no other function. The left-hand secondary is center-tapped, and through the arrowheads of its outside wires supplies the heaters of all th amplifying tubes. The grounded center-tap assists in eliminating a.c. hum. Directly above the ground connection as drawn, a pilot lamp is bridged across this winding. The pilot is mounted behind a colored bulls-eye on the face of the panel, and shows at once whether the amplifier is turned on or off. (There are no pilots associated with the exciter change-over switch, since the position of the large handle is always apparent at a glance.)

Plate Power Circuits

Tracing from positive to negative, the source of B supply may be taken as that plate of the rectifier tube which is positive at any given moment: trace to filament and thence right through the filter system composed of the choke coil and two 8-mfd. condensers bridging to ground at either side of that coil. From the right-hand side of the filter the circuit branches: one branch continues right and then bends upward to the center-tap of the output transformer. From the two ends of that transformer to the plates of the two 6L6 beam power output tubes. Thence to the cathodes of those tubes, left through the 180-ohm grid bias resistor, and down to ground. The return to the power source is through the grounded center-tap of the plate secondary of the power transformer.

Returning to the right-hand end of the filter system, another branch of the plate circuit is found running upward through 5,000 ohms to the screen grids of the 6L6 tubes, and from the cathodes of those tubes, as before, to the center-tap of the plate secondary of the power transformer, which is always the negative terminal of this circuit.

In tracing the other branches of this circuit, ground will be taken as equivalent to negative, which of course it is, and the upper end of the 5,000 ohm resistor as the positive terminal. From the upper end of that resistor, then, trace left, up through 1 megohm, up, right and up through ¼ megohm, to the left-hand plate of the 6N7 phase-inverter tube. From the cathode of that tube down through a 3,000-ohm grid bias resistor to negative or ground.

From the upper end of the 5,000-ohm resistor trace left as before, up as before through 1 megohm; up, right and down through ¼ megohm; left, up and left to the right-hand plate of the 6N7, and back to negative as before.

From the uper end of the 5,000-ohm resistor left as before, past the 2-mfd. condenser, up through 1 megohm, left past the 1-mfd. condenser, and up through 1 megohm. Thence right, up through ¼ megohm and left to the plate of the right-hand 6J7. Instead of taking that last turn right and then up through ¼ megohm, continue straight up through 1 megohm to the screen grid of the

same tube. In both cases return is from cathode directly to ground. There is no grid bias resistor in this return, grid potential for this tube being obtained through a bias cell.

From the upper end of the 5,000-ohm resistor trace as previously left, up through 1 megohm, and then left as far as possible, until the line branches upward and downward. This point of junction, at the bottom end of a 2-megohm resistor, will henceforth be considered the positive terminal.

From the point of junction at the lower end of the 2-megohm resistor, trace up through that resistor, then left, up through 25,000 ohms, up through 1 megohm, and left to the plate of the first of left-hand 6J7 tube. From the same point of junction up through 2 megohms as before, then left as far as possible and up through ½ megohm, further up and left to the screen grid of the same tube. The cathode of the tube is grounded; there is no grid bias resistor.

From the same point of junction at the lower end of the 2-megohm resistor turn downward, then left through three resistors and down through a fourth resistor to ground. This assemblage of four resistors constitutes a voltage divider equipped with three taps, wired to a terminal board, and provide a choice of three photocell voltages. Connection to any of the three, as desired, is by means of the flexible tap connector shown just above the terminal board.

From that flexible connector trace up through 1 megohm, up through 3 megohms, left and then down to the two positive terminals provided for the p.e. cell cable connections. The corresponding negative terminals, wired to the photocell cathodes, are grounded in the drawing.

Grid Bias Circuits

The necessary grid potential for the two 6J7 tubes is provided by bias cells. These are a new special type of "C" battery that never need changing, and are *permanently* wired into the amplifier. Unlike the "C" batteries used previously, these are not flashlight cells, originally designed to produce current as well as voltage and adapted to an alien use. Modern bias cells produce no current, and are not intended to. They are specifically built for the purpose of biasing vacuum tube grids and would be ruined in a few seconds if used to light the smallest flashlight bulb.

In the intended service, the bias cell delivers no current whatever, thus it does not wear out, become noisy, or lose voltage. The flashlight cells formerly used for C bias were not expected to last indefinitely and were not internally protected against causes of slow deterioration. The bias cell, however, is built of exceptionally pure materials, eliminating local action, and is intended to last and deliver rated voltage for the life of the amplifier.

From the bottom or control grid of the left-hand 6J7 tube trace left, down through the 5-megohm grid leak, and through the bias cell to ground. The grid circuit of the second 6J7 is precisely similar. Grid bias for the other three amplifying tubes, however, is obtained by means of a voltage-dropping resistor in the plate current return.

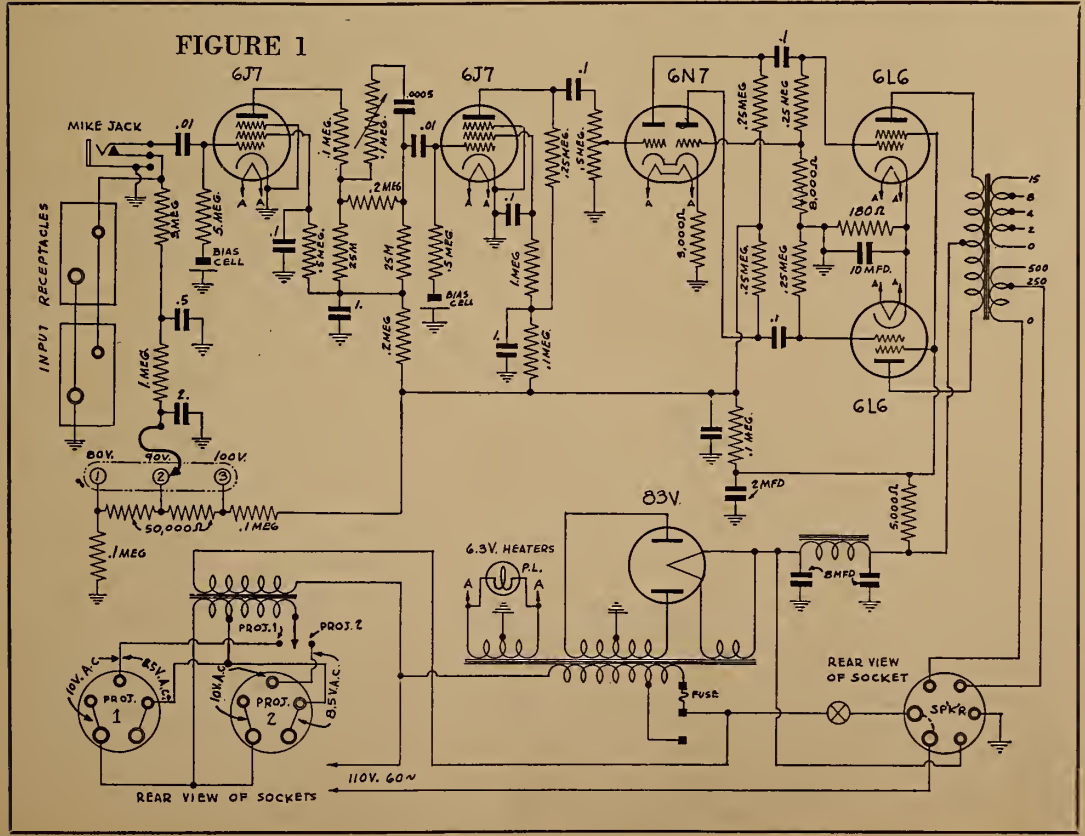
From the double cathode of the 6N7 trace down through 3,000 ohms to ground. That cathode is therefore positive with respect to ground, by the extent of the voltage-drop in the resistor. From the left-hand grid of the tube trace left to the volume-control potentiometer, and down to ground. The cathode is therefore positive with reference to the grid in question. The grid bias is not changed by varying the setting of the potentiometer, since that resistance carries no direct current, and there is no direct voltage-drop across it.

From the right-hand grid of the 6N7 trace right, down through 8,000 ohms, left a bit and down to ground. The 8,000-ohm resistor, like the potentiometer just mentioned, carries no direct current and has no effect on the grid bias, which is determined solely by the 3,000 ohms in series with the cathode and the plate current that flows through it.

From the cathode common to the 6L6 output tubes trace left through 180 ohms and directly down to ground. The cathodes of those tubes are positive with reference to ground by the extent of the voltage-drop existing across the 180-ohm resistor. The control grids of the two tubes return to ground through resistors that carry no direct current and have no effect on the grid bias. The control grids are the grids drawn nearest the cathodes. From the upper tube trace left, up, down through ¼ megohm, down through 8,000 ohms, right and down to ground. From the lower tube trace left, up through ¼ megohm, right and down to ground.

The two 6J7 tubes are pentodes, and in addition to the grids already examined, contain suppressor grids located nearest their plates. These are connected directly to cathode, thus are negatively charged. Their function is to suppress secondary emission, or negative electrons released by the plates under the pressure of relatively heavy electron bombardment, preventing distortion that

FIGURE 1



would otherwise result and permitting greater amplification.

The 6N7 is simply a double triode—two 3-element amplifying tubes built into a single glass envelope. A tube of this type is desirable for use as a phase inverter, since the internal balance of both triodes will always be the same, and any change in emission due to deterioration of the cathode or other causes will react equally on both plates.

The construction and action of the 6L6 tubes have been fully described in INTERNATIONAL PROJECTIONIST.†

The Speech Circuits

Speech input from the p.e. cells is wired to the two "input receptacles" shown at the extreme left of the diagram. The negative input line is grounded directly under the lower input receptacle. The positive lead from both photocells is traced from the receptacles up, right, down through 3 megohms, right through ½ mfd. and down to ground.

Regarding the cathode and anode of the photocell as the poles of a generator delivering speech a.c., the resistance just mentioned and the ½-mfd. condenser in series with it constitute the load to which the power is delivered. A fluctuating voltage-drop exists across that load when the photocell is in operation. One side connects to ground through the right-hand plate of the ½-mfd. condenser and hence to the cathode of the first 6J7, which also is grounded. The other side, from the top of the 3-megohm resistor, connects to the control grid of the first 6J7 as follows: up, left, through the microphone jack contact as drawn, right through the .01-mfd. coupling condenser and right to grid. Thus, the fluctuating voltage-drop existing across the load placed upon the photocell is extended to the grid and filament of the first amplifying tube, creating a fluctuating change in the voltage difference between that grid and cathode. A corresponding but greater fluctuating change then appears in the plate current across the tube.

When the mike jack is in use, the plug lifts the top contact out of touch with the central prong and thereby opens the p.e. cell speech circuit. The photocells in consequence will remain inoperative while the microphone is connected.

The Electronic Equalizer

The cathode and plate of the first 6J7 may be considered the poles of a generator of amplified speech a.c. From the plate trace right and down through 1 megohm, through 25,000 ohms, through 1-mfd. and to ground. From ground trace back to cathode. The 25,000-ohm resistor just mentioned is paralleled by two shunt circuits. One runs from the top of that resistor right through 2/10 megohm (or 200,000 ohms) and then down through 25,000 ohms and left to the lower end of the 25,000-ohm resistor first mentioned, hereafter called the source resistor for the equalizer circuit. The second parallel path around that source resistor may be traced from its upper end upward, right, up through a potentiometer, right, down through .0005 microfarads, down through 25,000 ohms and left as before to the lower end of the source.

Disregarding that second path for a moment, the 200,000-ohm resistor and the 25,000-ohm resistor shunted around the source may be considered a tapped voltage divider. The tap at the junction of the two connects to the grid of the next 6J7 tube through the .01-mfd. coupling condenser. The ratio of 25,000 to 200,000 is 1 to 8, and 1/8th of the source voltage is coupled to that grid.

The second shunt path, however, through the potentiometer, varies that ratio in accordance with the setting of the control and with sound frequency. Assuming the potentiometer to be set for zero resistance, the condenser alone will be paralleled across 200,000 ohms. The condenser will have almost no effect with reference to extremely low frequencies, since it will present a very high reaction to them; but at higher frequencies it will serve as a better conductor and decidedly modify the ratio of 8 to 1. Setting the potentiometer at zero thus results in increased high-frequency volume with very little change in low-frequency volume.

The effectiveness of the condenser, however, is reduced by bringing potentiometer resistance in series with it, and at maximum potentiometer setting its influence is comparatively small at any frequency.

The chart printed in INTERNATIONAL PROJECTIONIST for June, 1936 (p. 16), shows the range of tonal response that can be obtained by means of this equalizer. The circuit itself, as just traced, is electrically identical with the equalizer circuit diagrammed on page 15 of the same issue of I.P., but the resemblance is concealed by the fact that the drawings are laid out differently. There is also one difference in values, in that the right-hand 25,000-ohm resistor of the present circuit is represented, in the earlier drawing, by a resistance of 10,000 ohms. It may be instructive to compare the two diagrams in detail, insofar as the electronic equalizers are concerned, and to note how identical electrical arrangements underlie a wide difference in superficial appearance.

Phase Inverter and Output Circuits

The charge on the control grid of the right-hand 6J7 tube being varied by the input circuits just traced, the plate and cathode of that tube may be taken to represent the terminals of a source of amplified speech a.c. Cathode goes directly to ground. Plate is connected to the upper end of a ¼-meg. resistor, which returns to ground (trace downward and left) through 1 microfarad. A shunt path exists through the 1/10-mfd. coupling condenser and down through the ½-megohm volume control.

Any desired portion of the voltage-drop across that volume control is applied, by means of the slider, to the left-hand grid of the 6N7. The cathode of the same tube returns to ground through the 3,000-ohm grid bias resistor.

Now, one of the functions of the 6N7 is to provide push-pull input to the power tubes of the last stage, for which purpose the two plates of the 6N7 must be 180 degrees out of phase. But the plate of any tube is always 180 degrees out of phase with its grid, plate current decreasing as grid charge increases, and *vice versa*. Therefore, in the case of the 6N7, the right-hand grid is supplied with speech voltage by the left-hand plate, and the right-hand plate, being 180 degrees out of phase with its own grid, will be out of phase with the left-hand plate also.

From the left-hand plate trace up, right through the 1/10-mfd. coupling condenser, down through ¼ megohm and left to the right-hand grid. The two plates of the 6N7, being suitably displaced as to phase, can then be used to drive the two control grids of the output tubes. From the left-hand 6N7 plate trace up, right through 1/10 mfd. and down to the control grid of the top 6L6. From the right-hand 6N7 plate trace right, down, and right through 1/10 mfd. to the control grid of the lower 6L6.

However, it will be noted that the sound voltage supplied to the upper 6L6 has been amplified only *once* in the 6N7; while the sound voltage to the lower 6L6 has been fed back to the right-hand of the 6N7 and amplified *twice*. A proper correction must be applied, in the interests of good quality, to insure that the speech voltage supplied to both 6L6 tubes shall be equal in value.

Return to the left-hand plate of the 6N7 and trace up, right through 1/10-mfd., and down through ¼ megohm, through 8,000 ohms, and right and down to ground. The two series resistors, 250,000 ohms and 8,000 ohms, constitute a voltage divider with a ratio of about 30 to 1. The right-hand 6N7 grid is connected to the tap between those two resistors, and does not receive the full plate output of left half of that tube, but only about 1/30th of it.

In any properly designed phase-inver-

† I. P. for June, 1936, p. 22.

Final Mirrophonic Article To Appear Next Month

PUBLICATION of the second and final article relative to the W. E. Mirrophonic Sound Reproducing System, scheduled for this issue, has been deferred until next month. Photographs and drawings of certain Mirrophonic system components could not be prepared in time for this issue, and the presentation of this data in part was deemed inadvisable.

The concluding article of the Mirrophonic series will appear in the November issue.

sion circuit of this type, the resistance ratio of the voltage divider corresponding to the circuit just traced is the measure of the practical voltage amplification of the phase-inversion tube, which in this case is approximately 31. The double amplification applied to the speech input to the lower 6L6 is cancelled by the 30-to-1 volume loss in this voltage divider, and both output tubes are driven by speech input at the same voltage.

The plate current of the 6L6 tubes completes its circuit to cathode through the primary of the output transformer, and from the center-tap of that transformer down, left and down to ground through the right-hand, 8-mfd. filter condenser. The common cathode jumper returns to ground (trace left) through 10 mfd.

Speaker, Voice and Field Circuits

The tapped secondaries of the output transformer afford a wide range of output impedances. The 250-ohm output is shown connected in the drawing, and the lines from it run down and left to the two top terminals of the speaker socket. In the portable system in which this amplifier is often used, two 500-ohm speaker transformer primaries are wired in parallel to the corresponding terminals of the speaker plug.

The speaker field supply provided by Fig. 1 remains to be traced. Return to the rectifier circuit, in which the grounded center-tap of the plate secondary of the power transformer is the negative terminal, and either rectifier tube plate, whichever happens to be positive at any given moment, may be considered the positive terminal. From the plates trace to filament, and thence right. Instead of continuing right through the filter as before, turn down and right to the lower right terminal of the speaker socket. Then out at that terminal to the speaker fields, and back in at the right-side terminal, which returns to ground.

Resistance in Speaker Field

It will be seen that in this circuit the speaker fields form no part of the amplifier's filter, but are merely connected across the rectifier output, since they possess sufficient inductance to do their own filtering. Consequently, changes in the speaker field details will have no effect on the hum level of the amplifier, and if permanent magnet speakers or a.c. speakers are used there will be no need for substituting a filter choke. It will be advisable, however, to substitute a resistance, since the speaker fields in this circuit represent a drain upon the rectifier, and the plate voltage throughout the amplifier will increase to some extent if the speaker field circuit is left open entirely.

The output of the speaker field supply is 16 watts when applied to 10,000 ohms; and in the portable system incorporating this amplifier, two 5,000-ohm fields requiring 8 watts each are wired to the appropriate terminals of the speaker plug.

REPRODUCTION PROBLEMS, COLOR FILM FEATURE S. M. P. E. MEETING

By *JAMES J. FINN*

PROBLEMS incident to the reproduction of picture and sound in the theatre were accorded by far the most attention by the recent convention of the Society of Motion Picture Engineers, held in Rochester, N. Y., Oct. 12-15. Projection topics discussed ranged from simple test adjuncts to the more or less complicated color projection systems which have been developed by Eastman Kodak Co. in conjunction with optical, screen and lamp manufacturers. In addition, both major sound companies presented detailed expositions of new theatre sound reproducing systems.

The refining process so obvious in both the production and theatre reproduction fields during the past several years, still is manifest in the studios, but in the projection field it has been definitely supplanted by an aggressive development program—as was attested to by the agenda of this most recent Society meeting.

Reproduction Most Important

Of particular significance is the fact that an ever-increasing number of motion picture engineers are becoming convinced that the future progress of their industry depends in large measure upon not how expertly a picture can be made but upon how well it is reproduced in theatres throughout the nation. Anent this topic more elsewhere herein.

The success of the meeting was assured shortly after convening by the announcement that registration had exceeded an all-time high for the Society, more than 200 technicians and others registering before noon of the first day. A varied papers program engaged the interest of even the most confirmed specialist—although once more the program was overstocked and necessitated drastic curtailment of general discussion, which in several instances was most unfortunate. It is believed that future papers programs will be less heavily loaded so as to permit full discussion of all major points, a convention improvement most earnestly to be desired.

Eastman Kodak Co. and the Bausch & Lomb Optical Co. are deserving of special mention as perfect hosts, not only for opening wide the doors of their plants for inspection of the manufacturing process but also for their invitation luncheons and general all-around hospitality.

S. K. Wolf, of Erpi Picture Consultants, Inc., is the new president of the Society, succeeding H. T. Tasker, of Universal Pictures Corp. The new secretary is James Frank, Jr., of International Projection Corp; while L. W. Davee, of Erpi, will assume the treasurer's duties.

The Progress Medal of the Society was awarded to Dr. C. E. K. Mees, Director of Research for Eastman Kodak Co., not for any single development, but in recognition of his contributions to motion picture technology over a period of 35 years. The *Journal* Award for the best paper during 1935 went to Edward W. Kellogg, of RCA, for his contribution: "A Comparison of Variable Density and Variable Width Systems".

Abstracts of those papers which are of particular interest to the projectionist are appended to this article, thus making unnecessary any extended comment on their content herein. General observations on several papers, however, seems desirable.

Color Film Developments

Eastman Kodak Co. contributed two papers on color film that are particularly noteworthy. The first, "Color Photography." by Dr. C. E. K. Mees (abstract appended) encompassed virtually every known color process and cited the advantages or disadvantages, as the case may be, of each system. A particularly detailed statement anent the new Eastman Kodachrome process (three separation pictures made in the depth of a single film) constituted the first authoritative pronouncement on this system. Of more immediate interest to projectionists, however, is the paper, "The Projection of Lenticular Color Films," by Messrs. Capstaff, Miller, and L. S. Wilder, of the Eastman staff.

In the lenticular film process the film base is covered with microscopic lenses which form images of three color filters on the film. It follows, naturally, that the projection of this film must also utilize three filters in order to reproduce an approximation of the original picture photographed. The demands of this projection process (see abstract)

(Continued on page 20)


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THE STANDARD SOUND SYSTEM OF THE WORLD

REPRODUCTION PROBLEMS FEATURE S.M.P.E. MEETING

(*Continued from page* 17)

include an increased relative aperture, reduction of shutter loss, increased filter transmission, and lower print density. It was asserted during presentation of this paper that, these changes having been effected, the projector light output had been increased 425%.

Projection enthusiasts were particularly interested in details of this remarkable accomplishment. Questions were raised as to necessary lamp modifications, whether the *f*/1.6 lens employed were filled, whether reduced shutter area would not result in travel-ghost, and as to precise control of print density. Attention was also directed to the necessity for using a heat filter in the condenser system, the result of a substantial increase in radiant energy and accompanying heat.

Unfortunately, in the limited time available for discussion it was impossible to develop fully all angles of this process. The consensus of opinion among outstanding projection men, however, is that the process requires such precise control over all the elements involved as to render the system impracticable on any large scale in the theatre field. It was pointed out, not without valid reasons, that the black-and-white projection process after many years of use still has many obvious defects, due to common field practices, which in themselves would present an insurmountable barrier to the general introduction of the lenticular film process.

Interesting Projection Topics

Papers were presented by two working projectionists who were a credit to the craft: Victor Welman, secretary of Cleveland L. U. 160, read two: "New Recording Equipment," and "An Improved Reel-End Alarm," his associate in these presentations being D. Canady. The reel-end alarm utilizes a light source and a photo-cell, is positive in action and provides against any mechanical part touching the film, thus eliminating reel-end mutilation (see abstract). T. D. Hover, of Lima, Ohio, demonstrated a neon tube oscilloscope for projection room utility use which he built out of spare parts at a total cost of $2.80. Construction and operating details were given.

C. C. Dash, of the Hertner Electric Co., contributed an interesting paper relative to a new generator developed for use with Suprex arcs (abstract appended).

H. Anderson discussed "Fire Prevention in the Motion Picture Industry" (see abstract) in which he stressed the ever-present problem of properly handling a projection room fire. He pointed out that, while most projectionists know that a magazine door should not be opened during a projector film fire, the natural tendency is to forget and to attempt to "get the film out of there." The Society was asked to adopt a standard set of instructions covering exactly projectionist procedure in case of fire.

A paper on accelerated aging tests of film (see abstract) induced questions as to the proper temperature for storing film in projection rooms, with which was coupled an inquiry as to whether room temperatures were not responsible in large measure for buckled film. Lewis Townsend, of the Rochester L. U., stated that he considered buckling a function of the quality of stock, his experience being that new, first-run film buckled upon occasion, even with the use of rear shutters. Other comments related to the desirability of room cabinets being vented to the outside air, the absolute necessity for rear shutters, and the present acute print shortage, resulting from distributor "economy," which meant that existing prints are being literally "run to death."

A definite indication of the extent to which film projection is finding wide application outside the theatre field was given in the paper, "The Schwarzkopf Method of Identifying Criminals," by J. Frank, Jr., of International Projector Corp. This utilization of the motion picture in the war on crime reflects a noteworthy commercial engineering development and, of course, increased employment opportunity for projectionists.

Delivery of a paper relating to improved mercury arcs (see abstract) dissipated what slim prospects existed anent the application of this type of lighting to projection work. The paper stated frankly that the inherent flicker of this type arc, designed for a.c. operation, resulted in variable intensity which precluded its use for motion picture projection.

The Standards Committee reported that the 2000-foot projection reel length still was under discussion, a status which is of little import to the projection craft in the light of recent developments whereby craft opposition to the reel has subsided to the vanishing point.

Merlin H. Aylesworth, head of RKO, delivered the principal address at the semi-annual banquet of the Society, in which he flayed the double-feature practice; cited the necessity for increased admission prices; said that the radio and motion picture industries were not rivals but "partners in merchandising entertainment"—with television destined to "soon" make it a triumvirate—and scored the waste of money and manpower in the studios.

Some Projection Stalwarts

Projection was well represented at the convention—in fact, space limitations do not permit listing all the projectionists and manufacturers present. Attendant circumstances make it absolutely necessary to mention a few, however, despite the obvious hazards involved in so doing. For instance, there were present Dale Danielson, who flew from and to Russell, Kans., no mean jump in the interest of pure science; Fred Dudiak, of Fairmont, W. Va., who is not unknown to I. P. readers; the irrepressible proprietor of the sumptuous University Theatre in Boston, Mass.—the Rt. Hon. Stanley Sumner, the only exhibitor in America of our knowledge who knows the difference between a sprocket and a vacuum tube and who once contributed to a symposium on projection practices; and with this estimable exhibitor (the very word galls us) was his projection pontiff, Charley Parshley, also of the gorgeous University Theatre. Complete candor compels the observation that in the case of Messrs. Sumner and Parshley pure science was possibly ever so slightly adulterated—that is, less than 100 proof.

Appended hereto are abstracts of those papers of particular interest to projectionists, some of which will be published in their entirety in subsequent issues:

A REVIEW OF THE QUEST FOR CONSTANT SPEED

E. W. Kellogg
RCA

The importance of constant record speed in machines used for reproduction of music was realized by Edison and many other pioneers in sound recording. Crude performance from other standpoints made it hardly worth while for the earlier workers to attempt to obtain extremely high standards of speed constancy.

The flyball-type of phonograph governor came into the picture and has been worked so well that it has not even yet been superseded, although with synchronous motor drives for certain types of equipment, the governor is no longer necessary. Recording sound photographically probably began with

(*Continued on page* 28)

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—THE PUBLISHER

TROUBLES AND TROUBLE-SHOOTING IN MODERN THEATRE AMPLIFIERS

By *AARON NADELL*

THE electrical design and mechanical construction of modern sound amplifiers expose them to several types of trouble not present, or less common, in earlier equipment and, of course, eliminate or reduce others. Modern amplifier design also makes inadvisable some methods of trouble-shooting formerly used and enhances the desirability of others.

All amplifier troubles may be divided, roughly, into four general groups or classes: (1) outage or complete loss of sound, (2) low sound or loss of volume, (3) distorted sound or bad quality, and (4) hum or foreign noise in the sound.

Complete loss of sound is caused by definite breakdown of some part, wire or connection and (assuming proper amplifier design) is usually traceable to high line voltage. In all amplifiers, high-voltage produces harmful effects indirectly, through overheating of the parts. In modern amplifiers the result of overheating is pronounced because of their compact, crowded construction. In addition, modern equipment is more subject to direct damage from high voltage, because tubes and their bases (and sockets) are of smaller physical size, and because the sockets usually carry a greater number of prongs now that pentodes are widely used. Arcing over at the base of the tube, or at the socket, is favored by this type of construction.

This condition calls for both remedies and precautions. The only practicable cure is to keep on hand not only spare tubes but also spare sockets, particularly for the output stage where plate voltage is highest. Luckily, both tubes and sockets are so very inexpensive that even the smallest theatre can afford to carry a suitable stock of both.

Precautions include proper fusing of the amplifier (and, of course, a stock of spare fuses) careful control of line voltage and installation of modern inexpensive voltage regulators wherever necessary, and particular attention to socket cleanliness.

This last point is of special importance wherever the ventilating system is not arranged to draw carbon dust out of the projection room. This dust is impalpable and will penetrate everywhere. Settling on the underside of an amplifier socket it will form a conducting path and encourage arc-over. Wherever ventilating conditions are less than ideal the amplifier should be opened from time to time, and the underside of the sockets cleaned with a camel hair brush and carbon tetrachloride. The same treatment should be applied to the underside of the tube base, if the tube has been in prolonged use, or has remained unwrapped in the projection room for considerable time.

A new cause of partial outage of sound, or low volume, is associated with the use of pentodes. Short-circuiting, at the socket or elsewhere, of the resistor that isolates the pentode screen grid from the plate power supply, lowers sound volume. When the screen grid of a pentode connects directly to the plate of the same tube, the tube acts as a triode, and its amplification is reduced. Breakdown between the two leads will not normally occur, because the voltage difference between them is comparatively small, but may be induced by the presence of high-resistance conducting path, such as that formed by carbon dust. The possibility adds one to the causes that must be checked in case of loss of sound volume.

Loss of Sound Quality

The new popularity of tone control or tone equalizer knobs introduces the risk of unintentional misadjustment by the projectionist. Some popular amplifiers are now so built that they can be used with either 16 or 35 mm. film, merely by setting a control dial. With such amplifiers the tonal response may be impaired not only by a mistake in the setting but by an accidental touch.

A more serious cause of defective quality is introduced by the increasing use of Class AB amplifying circuits. Projectionists accustomed to the old amplifiers will remember that occasionally, at top volume, plate current meters would flicker, and sound lost its quality. Class AB amplifiers are so designed that this condition is introduced long before maximum volume is reached. A very large increase of power is obtained with the same small-size tubes.

With such amplifiers there is some sacrifice of quality when the volume reaches the point at which Class B operation sets in. In a Class AB amplifier of good design the difference is not very great and goes unnoticed. The distortion appears (normally) only when the volume becomes very high, and under those circumstances is not heard.

However, several sets of conditions may exist in which the Class AB amplifier operates as Class B before the volume (in the ears of the audience) is loud enough to mask the change in quality, and then sound is likely to seem definitely bad. This will happen when the ampilfier is too small for the theatre and the volume control has to be brought past the point for Class B operation merely to provide normal sound. The same condition exists when the amplifier is large enough for the theatre but not large enough for an inefficient speaker system. This condition is particularly common when flat speaker baffles are used in an auditorium that should, acoustically speaking, be equipped with some form of trumpet. Any temporary or permanent defect in the speaker system may result in the same loss of quality.

However, these conditions are not, strictly speaking, troubles in or of the amplifier. Under normal circumstances Class AB amplifiers present advantages in that they permit large expansion of the volume range with low-cost equipment, and without distortion that is very no-

Thank You

Excerpts from the current *Bulletin* of District 1 of the I.A.T.S.E. & M.P.M.O.U.:

It would be in order here to mention the great assistance and co-operation extended to us by "International Projectionist" and its editor James J. Finn, in this fight we now have on our hands. First an editorial in the August issue of this publication entitled "Man Power vs. Fire Extinguishers," an article well worth reading by every projectionist. Second, in obtaining for us copies of briefs on this subject and other valuable data gathered from experts and leading authorities on the subject of manpower in the projection room. This up-to-date publication, by the way, is in our opinion very deserving of support and well worth subscribing to by every projectionist.

ticeable when they are correctly used. Still they are troubles that were impossible with earlier amplifiers, all of which, except accidentally at peaks of volume, operated strictly in Class A.

Remedies do not lie with the projectionist of course, but with the management. Class AB amplifiers must be large enough, and speaker systems used with them sufficiently efficient, to prevent Class B operation except when the volume level at the ears of the audience is intended to be considerably higher than normal.

Sources of Hum

Hum, especially of the 60-cycle variety, presents particular difficulties in modern amplifiers in which very sensitive input circuits may be located within 12 inches of built-in power packs carrying raw a.c. In earlier equipment this difficulty was minimized, either by the use of batteries or by design that placed the earlier and more sensitive stages of amplification at a distance from the rectifier circuits that provided them with power.

In modern amplifiers using input transformers even heavy shielding of such transformers often proves unable to prevent a high level of hum pickup, and the transformers must be rotated until the angle is found at which hum is reduced to a minimum. After any work on the amplifier the transformer must be replaced at the same angle; also all wires and other parts must be positioned exactly as indicated by the manufacturer. If emergency repairs make it necessary to change the location of any wire or part, the transformer may have to be unbolted, rotated again for minimum hum, and bolted at a new angle.

In the small modern amplifiers grounding is also more important than ever before. Input cables to the amplifier (nearly always shielded) must be properly grounded to the chassis, and the chassis in turn grounded to earth. A loose earth connection, or one that has corroded with time, can produce a very high hum level. Hum in these amplifiers where the ground connection appears perfect, will sometimes be traced to a high-resistance condition existing between the water pipe, or other ground, and earth itself.

Another cause of hum lies in the increasing use of electrolytic condensers. These condensers not only cost little but embody in an object the size of an average tube capacitances that would require more than the bulk of a whole modern amplifier if they took the form of paper or mica condensers. Some types, however, have a tendency to dry out and lose their capacitance with the passage of time. If such condensers are used in the filter pack of the power supply rectifier, the background hum level may be found to increase slowly over a period of months or years. The remedy, of course, is to install new filter condensers.

Suspected units should be removed and measured for capacitance. In reconnecting, or in installing new condensers of this type, great care must be taken to insure that correct polarity is observed. An electrolytic condenser (except for special types not used in theatre amplifiers) must be connected in proper polarity or it will be destroyed, and the short-circuit through it may burn out the power transformer as well.

Various External Troubles

Modern amplifiers introduce possible troubles due not to any fault in the amplifier but to its efficiency. Extended frequency range accentuates such defects as noise pickup, high-pitched hums (commutator type, etc.) picked up from an external source, and speaker distortion.

The latter condition is the most common, and often results from attempting to use a modern amplifier with high frequency response in association with speakers never designed for such work. New forms of harmonic distortion appear in a speaker when handling sound frequencies it was never meant to handle. Here again the remedy lies with the management; the projectionist can only explain the need for it.

Flutter, however, is within the province of the projectionist to the extent that the fundamental design of his sound heads will permit eliminating it. Flutter increases rapidly as the frequency is raised† and is much greater at the modern limit of 8,000 cycles than at earlier limits. Here again an efficient amplifier reveals faults that exist elsewhere in the system.

However, the reverse condition also is true. Some speakers are inefficient below 150 cycles and throw a mantle of undeserved charity over power-supply hum originating in the amplifier. With modern speaker systems that may go down to 30 cycles, such hum cannot be covered up, and the precautions mentioned above assume major importance.

Hints on Tracing Trouble

The compactness and small size of modern equipment, the crowding of the component parts, and the complexity of tubes and circuits all add to the difficulty of tracing trouble. There is a further handicap in that the built-in meter is very nearly a thing of the past; there are so many circuits in a modern amplifier that meters to read them all would require more space than the whole amplifier contains. If meter-switching arrangements were used, their circuits would be as complicated and troublesome as those of the amplifier itself.

The modern trend, in fact, is to use a single meter with intricate meter-switching circuits that enable one instrument to read volts, amperes, ohms or decibels, as desired, but to divorce the whole thing from the amplifier. Separate instruments of this kind, called analyzers,

† Journal S.M.P.E., December, 1935, Page 501.

An Outstanding Example of Fine Craft Advertising



ELSEWHERE in this issue appears an advertisement, reproduced in miniature above, which so strikingly emphasizes two contentions advanced by I. P.—without gaining conspicuous support, it must be admitted—as to merit special editorial comment.

First, this advertisement acknowledges unreservedly the importance of the projectionist in the efficient operation of a motion picture theatre; a fact long known by impartial and well-informed persons but often denied by others. Second, it reflects an intelligent conception of exactly what constitutes effective advertising to the craft—the elements of which have frequently been stated by I. P. but which persistently elude a large majority of advertisers.

Because I. P. considers these points of the utmost importance, it welcomes the opportunity to congratulate RCA upon this advertisement—which, incidentally, is only one of a series of equally intelligent pieces of copy produced by this company.

So direct an approach to the projectionist is this copy, and so effectively does it merchandise that intangible commodity known as goodwill, that it cannot fail to appeal to the projectionist as a highly personalized message. Granting this much, it is almost certain that it will succeed admirably in accomplishing the purpose for which it was designed.

made in quantities for the radio industry, are correspondingly inexpensive. They embody the further advantage of operating upon the only points of the amplifier where the wiring is easily accessible, namely, the tube sockets. The tube is removed and a test plug wired to the analyzer inserted instead, while the tube is mounted in a socket provided for that purpose on the analyzer panel. This procedure permits all the voltages and currents applying to that tube to be read in a few seconds, while the entire amplifier and every circuit in it can be checked in about a minute. The approximate location of any internal fault is found almost at once, and the portion of the crowded chassis that needs direct inspection or voltmeter test is reduced to a minimum.

There is no other means for locating trouble as quickly. If a modern amplifier is opened for the purpose of applying the standard voltmeter or ohmmeter prods, the crowding of the equipment will present difficulties. Some terminals will be hard to reach. Tracing the wiring to determine the circuit relationships of any given resistor or condenser will consume considerable time.

If an analyzer is lacking, however, the following procedures may prove helpful:

Outage of Sound: Examine tubes to see if all heaters are lit; dim lights if necessary, being careful not to come into contact with high voltage in the dark. Replace all tubes so constructed that the heaters are not visible.

Test plate voltage of all tubes with voltmeter equipped with test prods.

If plate voltages test normal and all tubes light, test with headphones (high-resistance only) across plate load resistor of each tube. The phones may have to be equipped with test prods to reach some of the contact points. Apply this test carefully in the case of power tubes working into high-resistance loads, touch the prod to the contact for only a moment.

Low Sound Volume: Test with voltmeter across the screen-grid resistor of each screen-grid tube. Test with headphones as before, consulting circuit schematic, to locate point at which volume becomes lower than it should be.

Hum: Disconnect input source and short-circuit input terminals if they carry no power. In the case of photocell terminals carrying p.e.c. voltage, close these through a high resistance, such as 100,000 ohms. If the hum stops, check shielding and grounding of input wires.

If the hum does not stop, remove shield of input transformer (if any) to note whether it has shifted the angle of its position. Apply voltmeter across filter choke coils; no reading indicates short-circuit.

Apply voltmeter to rectifier tube socket to determine whether both halves of the rectifier tube are working; or replace rectifier tube.

Examine ground connection to amplifier chassis, and ground connection to earth, for poor or open contact.

Use headphones as before to determine origin of hum, and check wiring grounds in that stage of amplification.

Poor Quality or Distortion: Observe setting of tone control or equalizer, if any. Check tightness of tone control knob to its shaft; if the set-screw has become loose, setting of the knob and its shaft may not agree.

Replace push-pull tubes with spares known to be good.

Replace grid-bias rectifier tube, if used. Check contact to grid bias cells, if used. Read voltage-drop across self-bias resistors.

Read photocell voltages.

Check connections of internal tone-control condensers, if used.

The more common causes of trouble will be found by one or another of these tests, but the list is inclusive, and anyone with experience in trouble-shooting in the newer amplifiers will find others successful in practice.

One precaution must be emphasized. Practically all these tests and checks are made with power turned on. The small size and crowding of apparatus necessitates unusual care in avoiding high voltage, not only because of danger to the person testing but also because even modern test prods can easily short-circuit terminals located close together, unless they are very accurately applied.

Identifying Parts

Crowding of parts and wiring, plus the fact that many resistors and condensers look so much alike as to be difficult to distinguish, handicaps the worker on an unfamiliar amplifier. He will save much time in emergency if he has covered the amplifier in advance, with the current turned off, and numbered each part with india ink or paint. The corresponding numbers having been added to his schematic diagram, he will know exactly what he is doing and need much less time to make repairs.

Condensers of different value can usually be distinguished by capacitance and voltage readings printed on them. Resistors in many modern circuits are not marked, but colored in accordance with a standard code. Reference to that code, which is available everywhere, is the easiest way of telling them apart. The code is given herewith:

NUMBER	COLOR
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet
8	Gray
9	White
0	Black

Only two figures and zeros can be coded. Thus, a resistance value of 625 cannot be shown in the code, but 620 or 630 can.

The color of the resistor gives the first figure. Thus if its value is 620 ohms, the body will be colored blue. The color of the end of the resistor gives the second figure—for 620 ohms will be red; for 630, orange. The dot or band at the center of the resistor indicates the number of ciphers that follow the first two figures—in the case of 620 or 630 ohms, one cipher, color brown. If the value were 620,000 ohms, the dot would be yellow, indicating four ciphers following 62.

Once learned, the code is very easy to use, and when applied to a line-up of resistors in a modern amplifier will help greatly in distinguishing one from another.

A chart of standard tube sockets should also be available, for ready help in distinguishing between the prongs.

[NOTE: The chart of standard tube sockets mentioned here will be published in an early issue, probably the next.—Ed.]

Discomfort glare can in some degree be controlled by the design of the light unit. Blinding glare cannot in any degree be controlled by design of the light unit without at the same time unpermissibly influencing the lighting results. No unit has yet been devised by which discomfort glare can be measured. Blinding glare has, however, been reliably evaluated in terms of the lesser illumination which, in the complete absence of glare, would produce equal visibility.—*Trans. of the Illum. Eng. Soc., June*, 1936.

A projectionist finds that after getting all of the shorts ready for projection, he still has a seven-reel feature to examine. He has available only six reel compartments. His problem is to get the seven reels into the six compartments, without doubling. He solves the problem this way: He puts reels one and two in the first compartment; reel three in compartment two, next reel in compartment three, next reel in four, and the next in five. Then he takes one of the reels out of the first compartment and puts it in the sixth. Just a bit of psychology; but will it actually work in practice?

The most important terms in the study of sound are: wave-length, amplitude of vibration, velocity of sound, resistance, intensity, pitch, musical scales, speech-and-hearing range. What is your definition of these terms?

H.-I. ARC APERTURE TEMPERATURES AT VARIOUS RUNNING TIMES

By *A. C. HARDY, Ph.D.*
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

NOTE: The appended article was designed to aid the general introduction of the double-reel as an industry standard. Although self-explanatory insofar as its content is concerned, this article gives rise to other and, it is thought, more important considerations, the discussion of which by I. P. readers is invited.—*Editor.*

MOST persons have very hazy ideas as to the temperatures existing in motion picture projection machines; it seems to be a natural tendency to exaggerate the temperature of any object that may be touched when it seems hot to the skin. In order to obtain concrete evidence of the temperatures attained at various points of the projection machine, particularly at the aperture plate and in the magazines, tests were conducted recently to determine how quickly the temperature of the aperture rose and to what height it attained.

The tests were made on a standard Simplex projector, operated with film at the standard speed of 90 feet per minute. The arc current was maintained at 120 amperes, using standard high-intensity carbons—the positive carbon being 13.6 mm. in diameter and the copper-coated negative carbon being 7/16 inch in diameter. The room temperature was 77°F.

The test consisted in measuring the temperature of the aperture plate by means of a copper-constantin thermocouple securely fastened to the plate. Table A shows the temperature attained by the aperture plate as a function of the time from the start of the run to the finish. It will be noted that the temperature increased rather rapidly during the first six or seven minutes, and that thereafter it approached equilibrium very slowly.

The most significant and unexpected result of the test is the low maximum temperature attained by the aperture plate. Unquestionably the aperture plate is the hottest part of the projection machine with which the film can possibly come into contact. Despite the fact that the high-intensity arc was employed, the maximum temperature after more than 22 minutes of operation was only 201°F. at which temperature the aperture plate apparently reached equilibrium.

This temperature is far below the flash-point for film, and is, in fact, 11° below the temperature at which water boils. As a further check, drops of water were placed upon the film side of the aperture plate with a medicine dropper, while the machine was in operation, and it was found that the plate was not sufficiently hot to boil the water.

In addition to the aforementioned test, the temperatures in the film magazines were measured with a mercury thermometer, and were found to differ by not more than one degree from the ambient temperature of the room, namely 78°F.

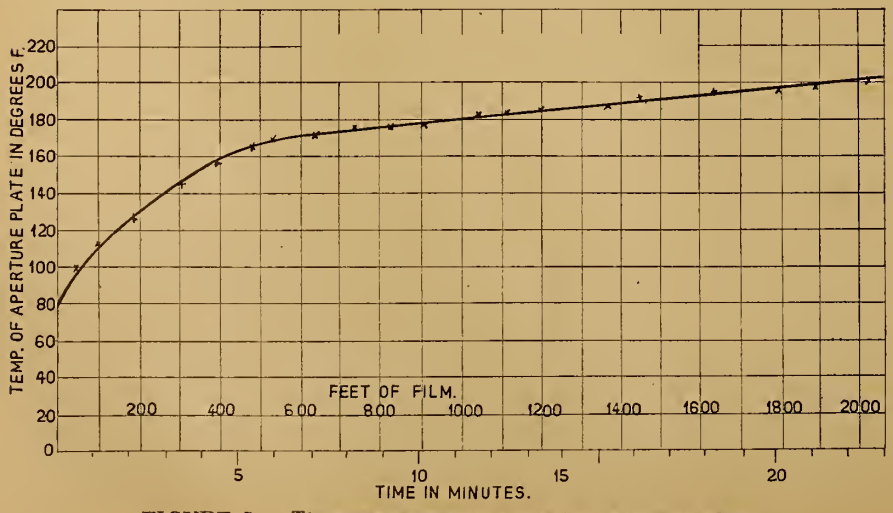


FIGURE 1. *Time-temperature curve for aperture plate*

TABLE A

Time-Temperature Data on Aperture Plate of Super-Simplex Projector Equipped With Rear-Shutter and Using H. I. Arc at 120 amps.

Elapsed Time Min. | Sec.	*Temperature in Degrees F.*
10	84.4
20	89.0
25	93.5
30	98.0
40	102.5
52	107.0
1.7	111.5
1.25	116.0
1.44	120.5
2.5	125.0
2.28	129.5
2.55	133.5
3.12	138.0
3.22	143.0
3.35	147.5
3.58	151.0
4.20	156.0
4.55	160.0
5.25	164.0
6.0	168.0
7.5	172.0
8.10	175.0
8.47	176.0
9.15	176.0
9.35	176.0
10.10	178.0
10.55	180.0
11.40	182.0
12.28	184.0
13.25	186.0
15.15	186.0
16.7	192.5
16.53	192.5
18.15	195.0
20.3	197.0
20.30	197.0
21.3	199.0
21.58	201.0
22.33	201.0

The question has been raised as to whether operating the machine for twenty minutes (2000 feet of film) would not create higher temperatures than operating for ten minutes (1000 feet of film). Figure 1 answers the question by showing that the temperature of the aperture plate rose rather quickly during the first five minutes of operation, after which it changed very slowly, and to only a small extent, up to the end of the 2000-foot reel.

The point may be made here that running 2000 feet of film on alternate machines will permit each machine likewise to cool for twenty minutes between reels; whereas, with the machines operating only ten minutes and attaining substantially the same maximum temperature during that period, the machine will have ten minutes less time in which to become cool.

In connection with this, it should be pointed out that if a sample of new

nitrocellulose film is placed into a test-tube, and the whole placed into an oil-bath and heated very slowly, the film will flash at a temperature of approximately 300°F. This does not, however, give a true idea of the temperature of the film as it passes the aperture, because, considering a given frame of the film, the frame will reach the aperture in a relatively cool state, and a certain length of time must elapse before it becomes heated. So long as the frame is moved away from the aperture before its temperature reaches 300°F., the film will not flash, and the increase of temperature of the frame in the aperture will still be further retarded by the drafts of air caused by the motion of the film through the machine.

In any event, as has been shown previously, contact with the aperture plate for *any length of time* up to twenty minutes (and even thereafter, because thermal equilibrium occurs after about seven or eight minutes) will not be sufficient to ignite the film.

From this study it appears that practically all the fire hazard that exists in the motion picture projection machine (barring negligence in operation) has its source in the light-beam. Inserting the thermocouple directly into the beam of light indicated a temperature of the thermocouple in excess of 1000°F. *practically instantaneously* when turning on the arc; whence it can be seen that such fire hazard as exists by reason of the direct beam has no bearing whatever upon whether 1000 feet of film or 2000 feet of film are run through the projector, but rather exists continually from the instant the machine is turned on.

THE Neobeam Oscilloscope is a new electronic measuring device using a gaseous discharge tube to make sound visible. The exact wave pattern is traced on the four-inch calibrated screen with clear definition between amplitude and frequency. The area of the glow covering the elongated cathode is proportional to the current passing through the tube. On a.c. the electrodes glow alternately, depending upon the frequency of the impressed voltage.

A power generator keeps the neon tube ignited. This is made up with a 6L6 beam power tube as a 100 K.C. radio frequency oscillator feeding directly into the neon oscilloscope tube. This system keeps a constant glow on the tips of the electrodes. The input potentials are amplified by a 6J7 and 6L6 high-gain audio amplifier and impressed on the power generator. This fluctuating power corresponds to the vertical deflection of the wave pattern and will, of course, be too fast to see without a sweep system.



The Sundt Neobeam oscilloscope for projection room work

In the Neobeam Oscilloscope the image is reflected on a revolving mirror so as to sweep the image horizontally across the line of vision of the observer. The sweep is controlled with a vari-speed motor unit calibrated in r.p.m. This direct reading feature is especially important in making frequency determinations.

One microvolt input is sufficient to produce a full scale deflection of the image on the calibrated screen. This extreme sensitivity is hard to imagine; for example, one foot of bare copper wire attached to the end of the shielded cable is connected to the input terminals provided sufficient pick-up to indicate a 60-cycle line five feet away. The unit measures 8¾" wide by 10" deep by 13" high and weighs twenty-five pounds.

Full operating details and circuit diagram are available from Sundt Engineering Company, Chicago.

NOTES *from the* SUPPLY FIELD

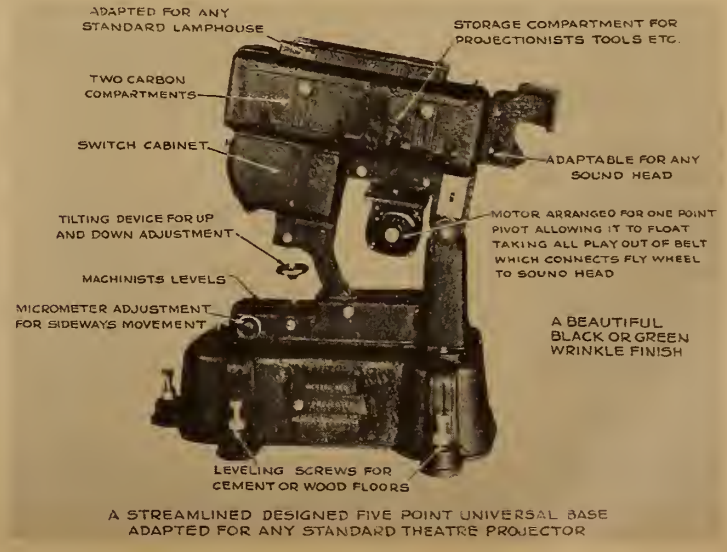
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WENZEL LINE CATALOGUED

The complete line of Wenzel visual and sound equipment is detailed in a new catalog just issued by this well-known firm. Listed items range from repair parts for all projectors to the Wenzel "Ace" 17-S amplifier. Parts for all standard sound equipments, including Erpi and RCA, are available through Wenzel. A new universal base (illustrated on this page) is announced, along a new enclosed hand rewinder with a ratio of 2¾ to 1, suitable for double reels.

Formal announcement of a complete projector will be made shortly. Full details and prices on all equipment may be had on inquiry to Wenzel Co., 2507 State St., Chicago.

The new Wenzel five-point, streamlined base for use with any standard projector. All important features are cited.



NEW BRUSH MICROPHONE

A new public address microphone known as the B-1 has been marketed by the Brush Development Co., Cleveland, Ohio. It offers at a lower price, though somewhat lower output, many of the operating features found in the Brush Sound Cell microphones.

Among its features are internal spring mounting, eliminating external shock absorbers and other makeshift attempts at external cushioning, and permitting the stand or even the microphone itself to be handled while it is in use; non-directional pickup, and the ability to run long leads with only slight loss. Wire mesh cases that permit the sound to pass through, eliminating the heavy bass and distortion of pressure-doubling and permitting close speaking, small size, and rugged construction are others.

NEW RECTOX BULLETIN

A new 12-page booklet (B-2078) describing the copper-oxide rectifier for changing a.c. to d.c. without moving parts or chemical reaction, is announced by Westinghouse Mfg. Co., East Pittsburgh, Pa. The booklet tells in easily understood language (1) what the Rectox is (2) where it can be used (3) summary of advantages (4) how to select the right size and type (5) pertinent application data including regulation, power factor, life and aging, continuous and intermittent duty; and a series of typical circuit connections.

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

NATION-WIDE adherence to the new double-reel standard is now an accomplished fact, following the collapse of organization opposition thereto. Chicago and Boston were the last two large cities in which craft opposition to the long reel was particularly intense; but Local 110 in Chicago removed its ban on doubles during the month, while Boston appears certain to follow suit shortly through the medium of a ruling by State authorities, whose decision Local 182 agreed to accept.

Chicago still has reel trouble, however, because of the refusal of the city electrical inspector to okay a 14½-inch standard reel, which permits a clearance of only ¾-inch between the reel and the standard 16-inch magazine. Approval of a 14-inch reel failed to satisfy distributors, who are continuing the fight for the larger size. Municipal authorities assert that their opposition to the 14½-inch reel is based on many projectionist protests anent insufficient clearance for efficient work.

The long-standing Chicago projectionist wage-scale dispute was settled during the month. Terms of settlement ignored both the Union demand for a 20% increase and exhibitor insistence upon pay reductions and less manpower, the net result being maintenance of scales and manpower pretty much as they were previously. Exhibitors agreed to improve sanitation and ventilation facilities in certain theatres.

RCA Service Staff Increased

RCA has added 25 specially trained service engineers to its Western staff to handle servicing work in the 300 competitively-equipped Fox theatres which recently went over to RCA. National service manager F. B. Ostman, after observing operations of the expanded service circuit, reported the new set-up functioning at 100% efficiency.

Re-Examination Held Invalid By N. Y. Supreme Court

A law requiring re-examination of plumbers in N. Y. City, as a means for weeding out incompetents and those who may have obtained licenses illegally, has been voided by the N. Y. Supreme Court. The court pointed out that the law "was born of the claim that some plumbers obtained licenses by fraud," the correction of which was to start proceedings for revocation of such licenses.

The court ruled that such a license "is a vested property of which the holder should not be deprived without due process of law." The decision is of great interest to projectionists, since it was hoped that a general re-examination of all N. Y. City projection licensees would aid considerably in thinning the ranks and thus easing the present acute unemployment situation.

Erpi Advances L. W. Conrow

L. W. Conrow has been named General Operating Manager of Erpi, advancing from a supervisory post in the Eastern Division. He will be in charge of all installation and servicing east of the Rocky Mountains, following the consolidation of the Eastern and Central headquarters divisions.

Patman Explains Price-Control Features of His Bill

Members of the Independent Theatre Supply Dealers Assoc. gathered in Chicago recently to hear Congressman Patman explain the so-called Patman Bill, the provisions of which threaten to force drastic changes in the Association's structure. Patman claimed that the bill gave independent dealers equality with the larger houses, would break up monopolies and enable the small exhibitor to purchase equipment as cheaply as the circuits. He said that prices would be standardized by dealers and that no deviation would be permitted.

The Bill, which was signed by the President last July, is aimed at chain stores and has already resulted in cancellation of various industry contracts on carbons, lamps, etc.

L. U. 253 Plays Host To S. M. P. E. Visitors

Local 253, of Rochester, N. Y., in addition to providing expert projection work at the recent S. M. P. E. convention, played host to visiting projection people at an annual clambake. The affair probably dented seriously the Local treasury, because there were many visiting projectionists and manufacturers present, none of whom was overlooked. Lewis Townsend, president of 253, presided, and was ably supported by his members in making the party a success. The manufacturers present asked I. P. to publicly acknowledge their appreciation and admiration of Local 253 in taking care of all visiting projection people down to the last man. No sooner said than done.

George Browne Named To A. F. of L. Exec. Council

George E. Browne, president of the I. A., has been appointed a member of the Executive Council of the A. F. of L., succeeding W. D. Hutcheson, president of the carpenters, resigned. Browne is the first Council member to come from the I. A., which is outranked and outvoted by numerous other A. F. of L. affiliates. Browne's capabilities evoked warm expressions of approval by A. F. of L. president William Green in a speech at the recent I. A. convention in Kansas City.

K. C. Local 170 Returns to Local Autonomy Basis

Kansas City projectionist L. U. 170 has resumed local autonomy, following a year of I. A. control, and will make its own deals. Officers elected are: John Morgan, president; Robert Dillon, business agent-secretary; D. L. McCullough, vice-president, and I. H. Burkert, secretary. Existing contracts are on an individual, oral basis of a contract that expired in August, 1935.

Erpi, RCA, German Pool

Extension until 1945 of a patent-pooling pact between Erpi, RCA and German sound-film interests has been accomplished. Under the pact the German companies enjoy exclusive sales rights in the so-called German territories. Extension beyond 1945 is sought.

American 16-mm. Standards Adopted Internationally

A world-wide agreement to assure complete interchangeability of 16 mm. motion picture sound film and equipment has been announced by the American Standards Association. The agreement, worked out through recent meetings of the International Standards Association at Budapest, will end a two-year controversy between motion picture industries here and abroad, by adopting the American practice as a universal standard. The agreement will open a world-wide market to the 16 mm. sound film industry.

German 'Stereoscopic' Process Utilizes Polarized Light

At a recent meeting of German theatre owners in Dresden stereoscopic films were shown. In place of the red-green glasses formerly used for stereoscopic effects, colorless "Herotar" filter glasses developed by Zeiss Ikon were employed. The process makes use of the principle of light polarization, two shots being made with light polarized in different planes. Each lens of the filter glasses supplied to the spectator admits the light of a single plane. The showing is reported to have been tremendously effective.

Disadvantages of the system are the eye-strain resulting from long continued use of the filter glasses and the expense of the glasses themselves.

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REPRODUCTION PROBLEMS FEATURE S.M.P.E. MEETING

(*Continued from page* 20)

the work of Alexander Graham Bell, who made records upon glass disks; but not until long celluloid films were available and the motion picture became thoroughly established, did photographic sound recording become a competitor of the disk. As late as 1930 there were many engineers who advocated the disk for sound picture work.

While the same general principle applies to both mechanical and photographic records, the latter involves certain additional problems. Among the earlier workers in this field, the expedients adopted by C. A. Hoxie and C. L. Heisler, of General Electric Co., deserve recognition. Brief descriptions and discussions are given of a number of ingenious arrangements for improving speed constancy which have been employed by various inventors and engineers. Some of these expedients have been applied to record turntables and some to film equipment.

THE SCHWARZKOPF METHOD OF IDENTIFYING CRIMINALS

J. Frank, Jr.

International Projector Corp.

At present there are only two means of sight identification generally in use—the still picture and the police headquarters line-up. Neither is particularly effective. The use of a sound motion picture which can be easily exhibited to widespread audiences in a short space of time is already regarded as one of the most useful developments in this field. Sound-film recording equipment of both the single- and the double-film type, and for both 16-mm. and 35-mm. technic, has been developed that provides for a picture about 3½ minutes long. The special apparatus and the technic developed are described, and actual motion pictures of actor-criminals shown to prove the method's effectiveness.

COLOR PHOTOGRAPHY

C. E. K. Mees

Eastman Kodak Co.

All processes of color photography depend upon splitting the light into the three primary colors—red, green, and blue-violet—making three separate pictures by the three colors, and then combining the three pictures again when they are viewed.

In the earliest processes, three quite separate negatives were made; from them three positives were made, and the latter were projected by means of three optical lanterns through suitable color filters so that the images fell on top of one another upon the screen and produced a color picture. Then methods were invented by which a multitude of tiny color filters covered the whole surface of the film, these filters being so small that they are invisible to the unaided eye. The picture taken through the filters and then viewed through the filters again is thus composed of a multitude of units, each of which is taken and viewed by one of the three primary colors. A process similar to this is the lenticular film process, in which the film base is covered with microscopic lenses which form images of the three filters on the film. The three images are then projected again through the three filters fitted to the lens of the projector.

Another method of making color pictures is to print each of the separation negatives, making the prints of colors complementary to the filters through which the pictures were taken; and then superimposing the prints so that the red filter negative is printed in blue-green; the green filter negative in magenta; and the blue filter negative in yellow. Essentially, this is the process used in producing color reproductions in magazines, each of the separate pictures being printed in its suitably colored ink and the printings being superposed.

In the multilayer processes, the three separation pictures are made in the depth of the film. The film has superimposed layers, each of which is sensitive to one of the primary colors. After exposure, the three images are converted into dye colors, either by the selective bleaching of dyes present in the coating or by the formation of dyes in the layers—by coupler development, for instance.

DEVELOPMENT OF THE ART AND SCIENCE OF PHOTOGRAPHY IN THE TWENTIETH CENTURY

C. E. K. Mees

Eastman Kodak Co.

An account of the developments in practical photography during the past thirty-five years and of the progress that has been made in our knowledge of the scientific principles of photography.

MODERN LOUD SPEAKING TELEPHONES AND THEIR DEVELOPMENT

C. Flannagan, R. Wolf and W. C. Jones

E. R. P. I.

The subject of modern loud speaking telephones is discussed with reference to efficiency, power-handling capacity, response-frequency characteristics, and distributional characteristics. Improvements and their significance are pointed out. The latest types of loud speaker are described and certain development problems discussed.



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MANUFACTURE OF MOTION PICTURE FILM

E. K. Carver
Eastman Kodak Co.

The manufacture of motion picture film may well be studied from the point of view of the research man, the technical man, the manufacturer, the machine designer, and the personnel man; the efforts of all of whom must be coordinated.

The fundamental requirements of manufacturing, after the emulsions and support formulas have been worked out, are cleanliness and uniformity. These are only to be obtained by a careful elimination of dirt at the source, an elaborate system of tests, and meticulous control of all processes. The flow of materials should approach as nearly as possible the ideal of continuous production.

The raw materials used are cotton linters, sulfur, sodium nitrate, camphor, and solvents for the nitrate base; cotton linters, acetic anhydride, acetic acid, triphenyl phosphate, and solvents for safety base; and hides, silver, nitric acid, potassium bromide, and sensitizing dyes for the emulsions. The nitration and acetylation of cellulose require more careful control of the original cellulose and of the conditions of reaction than is necessary for other purposes, but otherwise the standard practice is followed.

In making the "dope," the cellulose ester, plasticizer, and solvents are carefully mixed in large mixers, with continuous filtration.

The coating or casting is carried out on large drums or wheels many feet in diameter and up to approximately five feet in width. With some systems, flexible metal bands are used in place of wheels. The coating surfaces are carefully polished and plated in order to give a smooth surface to the film support. A current of warm air is passed around the periphery of the drum in order to evaporate the solvents from the "dope," after which the film support is stripped from the wheel and subjected to further treatment, such as subbing, tinting, further drying, *etc.* The subbing is necessary in order to make sure that the gelatin emulsion will adhere to the film base.

The simple processes of emulsion making are well known: uniformity is here attained, as in other parts of the manufacture, by carefully testing all raw materials and rigidly controlling all the details of the process, demanding, as well, years of experience on the part of the emulsion maker.

The emulsion-coating operation is carried out by passing the film support, subbed side down, under a roller partly immersed in a pan of melted emulsion. The speed of coating and the temperature of the emulsion govern the thickness of the emulsion coating. Immediately after the coating, the emulsion is chilled to set it in place, and then dried under carefully controlled humidity, temperature, and air-velocity conditions, by passing the film in festoons through a long tunnel drier. The air used in drying the emulsion must be controlled as to relative humidity within a very small range if best results are to be obtained, since the speed of emulsions is sensitive to changes in moisture.

The slitting and perforating of a film should also be carried out under controlled humidity conditions. The slitting is done by revolving knives, equally spaced above and below the film, to get a shearing action, the upper knife having a keen razor edge, and the lower knife a sharp square edge. The perforating is done by punches and dies so accurately made that the punches can not be inserted in the dies by hand without injury, although when clamped in the machines, they go in and out thousands of times without appreciable wear. Each punch consists of eight punching members and eight positioning members. The positioning members have tapered ends and fit the holes previously punched so as to position the film exactly for the next set of holes to be made.

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STABILITY OF MOTION PICTURE FILMS AS DETERMINED BY ACCELERATED AGING

J. R. Hill and C. G. Weber
National Bureau of Standards

Motion picture film of the safety type shows great promise as a material upon which to preserve records of permanent value, according to tests made at the Bureau. This type of film, having a base of cellulose acetate, is designed for use where the highly combustible film of the ordinary theatre type, cellulose nitrate, presents too great a hazard from fire and explosion. In addition to its safety features, it appears to have the additional advantage of being much more lasting. Both types of film were studied by determining the effects of various accelerated aging treatments upon samples of new film. Samples of old nitrate were tested also to determine their condition after natural aging.

The most satisfactory accelerated aging treatment found consists in heating the film in a dry oven, at 100° C., a test employed to find the relative stability of record papers. The films were tested for physical and chemical properties before and after oven-aging tests of various durations, and changes in the properties noted. High retention of folding endurance and viscosity, and small increase in acidity are considered indicative of stability. The acetate film was found to be excellent in these respects. Large losses in folding endurance and viscosity, plus large increases in free acid in the material characterized the changes in nitrate under the heat test. Its poor stability was further indicated by rapid change of resistance to an ordnance test used to determine the condition of smokeless powder.

The cellulose acetate film withstood oven-aging for 120 days without serious chemical or physical changes, while the nitrate film deteriorated beyond usefulness after 10 days under the same conditions. The acetate appears to have lasting qualities comparable to those of permanent-record papers of high quality, and the optimal atmospheric conditions for the preservation of paper records are suitable for this film. Nitrate film is perishable. and its deterioration is greatly accelerated under warm, moist conditions. The preservation of valuable nitrate film is a complicated problem involving both elaborate fire protective measures and air-conditioning.

FIRE PREVENTION IN THE MOTION PICTURE INDUSTRY

H. Anderson
Paramount Pictures

This subject is extremely broad, since the motion picture industry embraces practically every known fire prevention problem. It is of the utmost importance, because of the combustible nature of motion picture film, the necessary consideration that must be given to safety of life in the operation of theatres, and the serious financial effect of the interruption of studio operations by fire. It is further complicated by the extreme susceptibility of sound recording and reproducing equipment and of finished motion picture film to fire and water damage.

Motion picture exchanges have had an amazingly excellent fire record, the lowest fire loss record of any industry in the U. S. This is the result of the adoption of active fire prevention measures by the exchanges,

as described in this paper. It is suggested that the S. M. P. E. interest itself in active fire prevention work in the industry, and that individual motion picture engineers keep fire prevention in mind in connection with their work, whether it be operation or design.

The chemistry of fire extinguishing is discussed, as also the various types of fire apparatus. The principal types of fire extinguisher are described, and their effectiveness and defects brought out particularly with respect to their application to the motion picture industry. A description of experiments made with a new type of high-pressure spray system is given. The standard methods of fire prevention in laboratory, exchange, and theatre are discussed, and a detailed description is given of the fire problem in motion picture studios. The special apparatus necessary due to the severity of the problem, and the organization and procedure of the studio fire department are described.

While the National Fire Protection Association and insurance companies have established standard requirements for the installation of fire equipment in projection rooms, exchanges, and in connection with sound equipment, no set of instructions has ever been prepared for the benefit of motion picture projectionists at time of fire. The problem constantly arises as how to handle a fire properly in the projection room. It is recommended that the S.M.P.E. adopt a standard set of instructions which will tell the projectionist exactly what to do in case of fire.

A motion picture showing various fire-preventing devices, and fire apparatus in action in a motion picture studio was shown at the conclusion of the paper.

TRICK AND PROCESS CINEMATOGRAPHY

J. A. Norling
Loucks and Norling Studios

Process photography, which is the broad classification given to all branches of special and trick cinematography, plays an important part in making today's motion picture. Many articles have appeared relating to this subject, but, unfortunately, most of them have been devoted only to a discussion of the importance of this branch of photography and very few writers have divulged any of the details of the methods employed. This paper sets forth in general the underlying procedure in the various branches of the art, and treats many phases thereof in sufficient detail to be fully informative.

The branches of process photography disclosed include: transitional effects, such as dissolves and wipes; matte shots; simple and intricate multiple exposures; composites and montages; animated titles and presentation effects; combined drawing and actual photography; optical trick printers and cameras; miniature projection background process; problems in making dupe negatives by projection, dodging, etc. Important steps are described and illustrated, and special apparatus will be shown and their essential functions and operation described.

PROJECTION OF LENTICULAR COLOR FILMS

J. G. Capstaff, O. E. Miller and L. S. Wilder
Eastman Kodak Co.

In the projection of lenticular color films a large portion of the incident light is lost by absorption in the tricolor filters. To determine the feasibility of satisfactorily showing these films in large theatres, an experimental projector was set up embodying the few simple changes in standard theatre equipment that were necessary to obtain the required large increase in screen illumination.

Successful demonstrations with the apparatus at *Loew's Rochester Theatre* at Rochester, and at the *Center Theatre* at New York, have proved that it is quite possible to secure enough screen brightness to give a satisfactory showing of the lenticular films in the majority of theatres.

The principal changes made in the standard projection apparatus in order to obtain the greatly increased illumination were as follows:

(1) *Increased Relative Aperture.* — By substituting an *f*/1.6 projection lens for the *f*/2.4 lens commonly used, and by increasing the working relative aperture of the 65-ampere, high-intensity reflector arc so as to take full advantage of the increased aperture of the projection lens, it was possible to get 2.25 times the screen illumination obtained with the regular equipment.

(2) *Reduction of the Shutter Loss.*—A further increase was obtained by the use of a quicker pull-down and a corresponding reduction in the angle of the shutter blades; this may not, however, be feasible in practice.

(3) *Increased Filter Transmission.*—As a result of numerous practical tests it was found to be possible to increase the transmission of the tricolor projection filters by 33 per cent, without undue loss of color values.

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resultant increase in the brightness of the projected image amounts to some 25 per cent.

The large increase in the radiant energy directed onto the film has made it necessary to employ a heat filter in the condenser system.

Refinements in the present system are expected to produce additional small increases in illumination, and it is believed to be possible to develop other special equipment to take adequate care of the few (special) cases where it is necessary to project upon an unusually large screen.

EFFECT OF LENS ABERRATIONS ON IMAGE QUALITY

W. B. Rayton
Bausch & Lomb Optical Co.

Lenses are used to form images for two principal purposes: first, to produce the most accurate record possible of the original object; and second, to produce a pleasing effect. The character of the image formed by a lens depends upon diffraction and upon the residual aberrations left after the designer and the manufacturer have done their best. For pictures of the first type it is desirable that aberrations be reduced to a minimum, but for pictures of the second type they are very often deliberately employed to produce desired effects. In motion picture projection, lenses of the first class are doubtless always desired. In motion picture photography, some attention has been given to achieving special effects by deliberately introducing aberrations into the lens.

Among the many aberrations that afflict lenses, one of the most important is chromatic. Since, in general, only two colors can be brought to a common focus, some thought has been given to the question of what two colors are best to choose to meet the requirements of various kinds of lighting and different types of sensitivity of the emulsion. Recent experiments indicate that for a combination of particular interest in motion picture photography, namely, incandescent lighting and super-pan emulsion, no significant difference in performance is detectable among lenses of 12-inch focus or less, depending upon whether the two colors chosen for chromatism are yellow and violet, or red and violet.

THE INFLUENCE OF SPROCKET-HOLE PERFORATIONS UPON THE DEVELOPMENT OF THE ADJACENT SOUND-TRACK AREAS

J. G. Frayne and V. Pagliarulo
E. R. P. I.

An unmodulated sound-track when developed shows 96-cycle modulation. The effect is a maximum at the edge of the sprocket holes and diminishes exponentially for a distance of approximately 30 mils into the sound track. A film modulated with a constant frequency shows 96-cycle amplitude and frequency modulation over the same area. Both effects are introduced principally during processing of the film. A film having no sprocket holes on the sound-track side is entirely free of these effects.

REPORT OF THE STANDARDS COMMITTEE

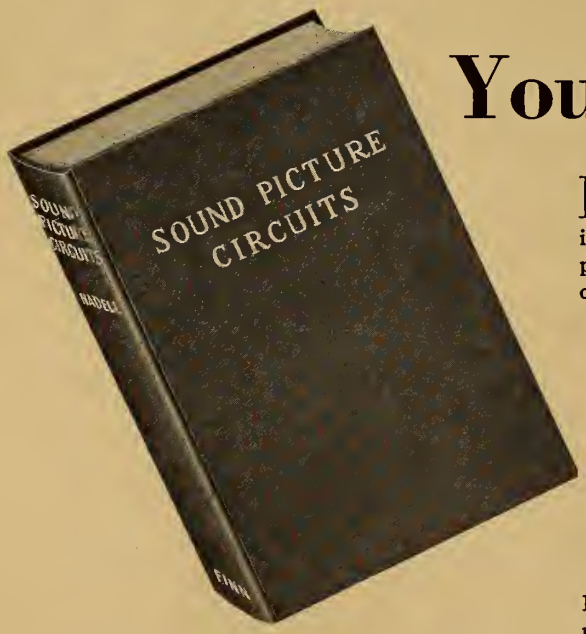
E. K. Carver, *Chairman*

Since the last report of the Standards Committee, drawings have been completed for a new booklet, changing the form of the drawings to conform to the American Standards Association specifications.

No fundamental changes have been made in the dimensions, but the 16-mm. sound-film drawing has been changed to a slight extent to conform better to current practice.

A sub-committee is at work on the question of a single type of perforation for both negative and positive, and the early proposal that a perforation having the dimensions of the old negative perforation and the shape of the new positive perforation be adopted as standard has been brought up again, due to the difficulty of accomplishing the adoption of the present standard perforation by the users of negative film.

The proposal made by the German Standards Association that 16-mm. film spools



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be standardized with square holes on each side has been referred to the sub-committee on sub-standard film, and a report has been received from them.

The standardization of 2000-foot reels is still under discussion.

MERCURY ARCS OF INCREASED BRIGHTNESS AND EFFICIENCY

L. J. Buttolph

General Electric Vapor Lamp Co.

The low brightness, 15 candles per square-inch, of the Cooper-Hewitt mercury arc, while an asset in industrial illumination, has prevented possible applications of the lamp where high brightness and, consequently, small source areas are essential for use with reflectors and refractors, and are valuable for use where space is at a premium. The Cooper-Hewitt quartz mercury arc represented an increase of 500 to 1000 candles per square-inch, which permitted compact reflectors but still meant too large a source for satisfactory control by optical means. This brightness has still been so low compared with the 10,000 foot-candles per square-inch possible with incandescent lamps and the 100,000 characteristic of the crater of the carbon arc, that little serious thought has been given to the mercury arc for projection or for long-range floodlighting work.

The recent development of so-called super-high-pressure mercury arcs has now opened up some of these possibilities. By designing a quartz mercury arc to operate at mercury vapor pressures of 20 to 30 atmospheres instead of the 1 atmosphere characteristic of the older high-pressure arcs, brightness of the order of 5000 candles per square-inch is attained in air-cooled lamps. By operating water-cooled arcs at higher pressure, brightnesses of 100,000 to 250,000 candles per square-inch have been attained during rather short lamp lives. Of the possibilities ranging in rating from 50 to 10,000 watts, only one unit thus far has been standardized for manufacture in the United States.

The 85-watt, type *H*-3 mercury lamp may be thought of as a small version of the type *H*-1, 400-watt and the type *H*-2, 250-watt mercury lamp standardized during the past few years. It is operated from a similar reactive transformer providing 440 volts for starting and 250 volts at the arc terminals, at a normal arc current of 0.4 ampere. It is rated at 35 initial lumens per watt in the arc and for a 500-hour life. The quartz tube of the arc proper is enclosed in an outer insulating bulb of ordinary glass, which limits the short-wave end of the spectrum to about 320 μm. Through the visible and near-ultraviolet range the spectral distribution is similar to that of other high-pressure mercury arcs except for the unusual intensity of the 365 μm lines.

The effective dimensions of the light-source or arc proper are about 0.6 by 0.15 inch, but the discharge is of the constricted type, giving a higher maximal brightness than the dimensions would indicate in calculation.

This arc is of the oxide-coated electrode type, designed only for a.-c. operation. Since the light output follows approximately the arc current, its intensity is variable; and although the flicker is not noticeable directly, it is such as to produce strohoscopic effects on moving objects, and may he a limitation in photography or in projection where motion is involved.

It is believed that the high intensity of the 365 μm lines and the high brightness of the source may permit application of the lamp to certain of the more highly specialized lighting problems in the motion picture industry.

A NEW TYPE OF PEAK READING VOLUME INDICATOR

F. L. Hopper

E. R. P. I.

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recording. Its advantages are: indication of peak values of voltage; full indication for sounds of short duration; adjustment for slow restoring action for greater ease of reading; the device may be given the same sensitivity-frequency characteristic as that of the light-valve; use of a well damped long-scale indicating type of meter.

A NEON-TYPE VOLUME INDICATOR

S. Read, Jr.
RCA

A number of gaseous discharge lamps of the neon type have been used to indicate instantaneous peak amplitude of audio-frequency voltages. When the instantaneous value of the signal voltage increases to the value at which the first lamp is adjusted to discharge, the lamp starts to glow. When the voltage is still further increased, additional lamps begin to glow as their discharge values are reached. As the instantaneous voltage decreases the lamps are extinguished in the reverse order.

Such a device provides a definite indication of the peak value, even though of extremely short duration. Due to the persistence of vision, such extremely short peaks are not lost, although voltages sustained over longer periods produce brighter glows. Only one-half of the voltage wave actuates the neon lamps; therefore, either positive or negative peaks may be noted. Any portion of the scale may be expanded or compressed as desired. Radiotrons of the Acorn type are used so as to achieve a compact unit.

The device is compared with volume indicators of other types, and some of its unique circuits are discussed. Diagrams and performance curves are included.

A NEON TUBE OSCILLOSCOPE FOR THE PROJECTION ROOM

T. D. Hover
Ohio Theatre, Lima, Ohio

A neon type of rotating mirror oscilloscope is described intended for routine use by projectionists to aid in eliminating noise due to microphone tubes, improperly meshed gears, etc. The parts may be either purchased or built by the projectionist.

NEW RECORDING EQUIPMENT

D. Canady and V. A. Wellman
Canady Sound Appliance Co.

A new sound-film recorder for studio or portable use is described. Three flywheels in addition to a non-resonant drive sprocket filter enable the machine to operate satisfactorily on power lines of poor regulation. Tests have proved that violet surges on the power supply line have no noticeable effect upon the linear film speed. The recorder is unusually quiet in operation. It can be used on the set if need arises. Mention is made of recording lamp improvements, and a noise-reduction unit for operation in connection with glow lamps is described. A self-contained semi-portable recording amplifier is also discussed.

AN IMPROVED REEL-END ALARM

D. Canady and V. A. Wellman
Canady Sound Appliance Co.

Scratching and mutilation of release prints by mechanical reel-end alarms in projectors are touched upon, and a description of an improved indicating device is given. Use is made of a light-source and a photoelectric cell. The light-rays from the light-source pass at a tangent to, or across, the film. When the point of tangency has been reached, the film that previously obstructed the light-ray allows the ray to reach the photoelectric cell, which, in turn, actuates the signalling device. The device is positive in action and automatic in operation. Nothing mechanical touches the film.

RECENT DEVELOPMENTS OF H.-I. ARC SPOTLAMPS FOR MOTION PICTURE PRODUCTION

E. C. Richardson
Mole-Richardson, Inc.

In order to utilize high-intensity carbon arcs more effectively as sources of illumination for photographic purposes, two newly designed spotlamps have been developed. Improvements have been incorporated in the design which particularly adapt the lamps for use under modern photographic conditions, particularly in the production of colored motion pictures, where uniformity of special distribution and intensity are vital factors.

In the design of the arc mechanism used in these lamps, vital improvements are: (1) increased rotational speed of the positive carbon; (2) continuous non-intermittent feeding of both positive and negative electrodes; (3) rapid-action positive and negative manual adjustments.

The paper describes in detail the application of "Morinc" flat corrugated lenses to the new equipment, and illustrates, by means of graphs, the light distribution attained for various beam divergencies. The new equipment has had sufficient practical application in motion pcture production to have proved its worth in photographing under both normal and Technicolor production.

THREE-WIRE D-C. SUPPLY FOR PROJECTION ARCS

C. C. Dash
Hertner Electric Co.

The introduction of the non-rotating, high-intensity, low-voltage, d-c. arc has made it desirable to use a d-c. supply of as low voltage as practically possible. The auxiliary projection equipment, such as the spotlamp, dissolver lamps, and effect machines, are still equipped with arc lamps requiring 55 to 65 volts across the arc. In order to obtain the benefits of the new lamps using the Suprex type of carbon, it is desirable to have a d-c. source of the proper voltage for each type of lamp to be used.

Two flat-compounded generators may be connected in series so as to have the voltage of each generator available or the combined voltage of the two in series.

There has been developed a double-voltage motor-generator arranged so that low voltage is available for the non-rotating high-intensity projection lamps, and also double the voltage of the single generator for the auxiliary equipment. The design of this type of motor-generator may be such that changing the load on either generator does not affect the output voltage of the other generator. Performance curves of this two-unit motor-generator set demonstrate the steadiness of the output voltage with changes of load.

A DEMONSTRATION TRIODE FOR VISUALIZING ELECTRONIC PHENOMENA

F. E. Eldridge and H. F. Dart
Westinghouse Lamp Co.

To augment theoretical discussion with a practical demonstration, a new type *WL*-787 triode has been developed for visualizing the electronic effect when changes are made in the grid and plate voltages of a vacuum tube.

The filament consists of several parallel oxide-coated wires, all of which are located in one plane so that the plate current will be uniformly distributed. The anode is the fundamental flat plate mounted parallel to the plane of the filament. The grid is a fairly open and conventional structure, mounted between the filament and the plate. The side of the anode facing the grid and the filament is coated with willemite, which shows a bright greenish fluorescence when bombarded by electrons of the plate current. A pronounced and clearly visible glow occurs at all points where the electrons strike, resulting in a definite pattern of the grid upon the plate. Plate size is such that the action can be observed by everyone in a room of reasonable size. Either alternating or direct current may be used to heat the filament and to supply the voltages for the grid and plate.

The demonstration triode, therefore, becomes a tool that can be used in the classrooms of universities, colleges, and technical schools to supplement the theoretical discussions. It is useful also for demonstrating visually any vacuum tube phenomena depending upon the fluctuation of the grid voltage to vary the plate current.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933,

Of INTERNATIONAL PROJECTIONIST, publisbed monthly at New York, N. Y., for October 1, 1936.

County of New York } ss.
State of New York }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared James J. Finn, wbo, baving been duly sworn according to law, deposes and says that he is the Editor of INTERNATIONAL PROJECTIONIST and tbat tbe following is, to the best of his knowledge and belief, a true statement of the ownersbip, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by tbe Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, James J. Finn Publishing Corp., 580 Fifth Avenue, New York, N. Y.
Editor, James J. Finn, 580 Fifth Avenue, New York, N. Y.
Managing Editor, None.
Business Manager, Ruth Entracht, 580 Fifth Avenue, New York, N. Y.

2. That the owner is:

James J. Finn Publishing Corp., 580 Fifth Avenue, New York, N. Y.
James J. Finn, 580 Fifth Avenue, New York, N. Y.
Ruth Entracht, 580 Fifth Avenue, New York, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or otber securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockbolders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of tbe company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

JAMES J. FINN, Editor

Sworn to and subscribed before me this 2nd day of October, 1936.
(Seal) JOSEPH HOPF

Notary Public Queen's County No. 718; Queen's County Register's No. 4309. (My commission expires March 30, 1937.)

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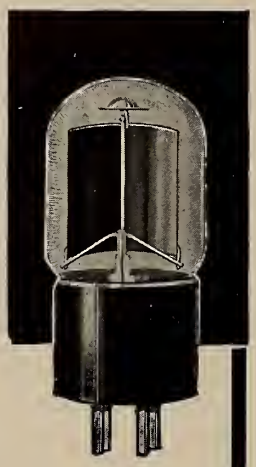
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NOVEMBER 1936 Vol. 11, No. 5

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International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

Volume 11 NOVEMBER 1936 *Number 5*

Index and Monthly Chat 5

Stray Sound System Noise a Difficult Checking Task 7
A. C. SCHROEDER

Projections 8
FRANK DUDIAK

Commercial Television: The Requisites for Its Success 11
DR. ALFRED N. GOLDSMITH

M. G. Sets Vs. Rectifiers for Carbon Arc Supply 14
JOHN H. HERTNER

Five Recent Fire Deaths Stress Poor Equipment and Lax Regulation 15
JAMES J. FINN

Christmas Seals—and the Unceasing War on the Dreaded 'White Plague' 16

The Neobeam Oscilloscope—What it is and How it Applies to Projection 17
E. V. SUNDT

The W. E. 91-A Amplifier, Unit of the 'Mirrophonic' Equipment 19
AARON NADELL

Notes From the Supply Field ... 22

Some Hazardous Properties of Motion Picture Film 23
A. H. NUCKOLLS and A. F. MATSON

News of the Month 24

News Notes
Technical Hints
Miscellaneous tems

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MONTHLY CHAT

NOW that television ballyhoo has been revived show business is once more wondering about the effect of this baby art on the future of the motion picture theatre. Once again Dr. A. N. Goldsmith supplies the answer in an article within, the second of his papers on television to appear in these columns.

This time Dr. Goldsmith addresses not the motion picture industry but those who will direct the destinies of television —which surely is the best means of getting the real low-down.

NOTHING has happened recently—including the release of the latest Technicolor production, "The Garden of Allah"—to weaken our preference for the well-lighted black-and-white motion picture. The latest color picture is always advertised as the "best ever," of course, and this is just where the trouble lies—there is too much of a good thing (color) and one is too acutely conscious of it. Of this more anon.

THE new double-track sound recording and reproduction will require more attention by projectionists and keep them alert. To which development this corner will have no objection—since the greater the responsibility the more important becomes the man behind the gun. If only this sense of responsibility would extend to all units, simple or intricate, of the projection room, there would be no need for impressing anybody with the importance of the job aloft.

WE NEVER cease marvelling at the insatiable thirst of projectionists for information on "something new"; and, as might be expected, those with the longest noses, so to speak, are those who have never even bothered about grounding themselves in the fundamentals of mechanics, optics or sound reproduction, without which, surely, volumes about "something new" are practically meaningless.

Here is a job that cries aloud to be done, preferably *en bloc*, by the craft leadership.

DR. HARDY'S article on H. I. arc aperture temperatures at various running times which appeared in our last issue (p. 24) fairly shrieked for critical comment by practical projectionists. A few comments were received—all of which missed the point entirely. It looks as though we shall have to do this job ourselves.

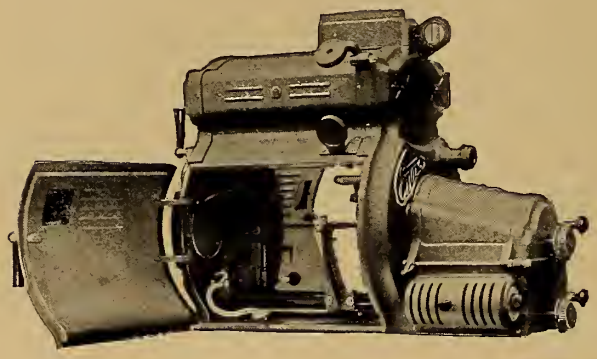
ONCE again it is our privilege to solicit the support of every reader to increase the sale of Christmas Seals. The projectionist craft is particularly indebted to these mighty little seals—so give generously.

We all cherish the theory that "it can't happen to me"—but it can and often does.

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INTERNATIONAL PROJECTIONIST

VOLUME XI NUMBER 5

NOVEMBER 1936

STRAY SOUND SYSTEM NOISE A DIFFICULT CHECKING TASK

By *A. C. SCHROEDER*

MEMBER, PROJECTIONIST LOCAL UNION 150, LOS ANGELES, CALIFORNIA

MUCH published material anent sound is of a theoretical nature, so let us consider an actual occurrence. Noise is a good subject, and is the cause of many puzzling situations, being hard to locate and usually cannot be heard in the projection room. We depend on reports from an observer in the auditorium, which system is something less than satisfactory. These reports usually do not help diagnose the trouble.

In this particular instance the dictaphone rang, and we learned that there was a "scratching noise" in the sound. One of us watched the filament meter on the Pec amplifier to see if it was wobbling; the other watched the filament meter on the 41 amplifier. Both meters were steady, so we assumed that the Pec amplifier probably was guilty, and that the watcher had failed to see the needle move, or that it was just plain onery and did not move while anyone was watching.

The rheostat usually causes this trouble in the Pec amplifier, so we cleaned it after that reel, and then calmly forgot about the noise, believing that it was gone. Everything was quiet for a few reels; but then the familiar ring on the dictaphone again, and the equally familiar voice at the other end saying, "It's still scratching. Can't you do something about it?"

"Sure, we'll fix it right up." This second call came in while we were running the other machine, although it developed later that the noise was not on that one. Our informant had heard the noise on the previous reel but had not called until some time later. But how were we to know about that?

Contacts The First Suspect

Thinking that this machine also was noisy, we gave it form X,. that is, we cleaned the filament rheostat. This failed to accomplish the desired result. Having first surmised that the noise had been present on both machines, and having cleaned the rheostats (the usual cause of such trouble) it was a natural deduction that the racket was in the main amplifiers, so we started in there.

The spare 41 and 42 were fired up, and the sound was switched through them. The noise was still there. This looked like it must be in one of the 43 amplifiers, and caused by poor contact of a tube in its socket. Killing one 43 at a time, we cleaned the tube prongs and the contacts in the sockets. Whew! Sixty-four tube prongs, and just as many socket contacts.

For good measure we cleaned the tubes and sockets in the 41 and the 42 that were not in use, also the filament rheostat and the main gain on the 41. We then switched back onto these two amplifiers, hoping that would be that.

No such luck. It was still "scratching." Back to the Pec amplifiers again. The grid leaks were twisted in their clips, thus cleaning the contacts and stopping any noise at this point. These are often soldered in, which is a good plan. The exciting lamp rheostats were then cleaned. Yes, this can produce a racket in the sound, as we know from sad experience, although many projec-

tionists do not think this is possible. The filament rheostat in the amplifier was then taken apart, cleaned again and more tension put on the moving arm.

By this time we decided to leave no stone unturned, so we "jiggled" the 264's in their sockets to clean up the contacts there. These are never cleaned the way we used to do it, that is by burnishing with an eraser or some other abrasive. The prongs of the 264-B's are silver plated, and if this is subjected to very much burnishing all the plating would be worn off. The spring contacts in the sockets were also silver-plated a long time ago, not only in the Pec amplifiers, but also in the 41's. This little stunt got rid of much grief.

Not being content with this, and thinking that we might have a noisy tube, we changed tubes in the one Pec amplifier. Before the reel was off of the other machine, the report from downstairs was that the noise is present for about a half hour, and then it was OK for a half hour, alternating back and forth in that manner.

After we interpreted this, it meant that one machine was noisy and the other one was OK. Well, that *was* something. Subsequently we asked our informant why he did not tell us that a long time before, because we could have had it licked much quicker. We explained just why it would have helped us, and if it ever occurred again to keep it in mind. The next time he probably will not be on the floor, and all our fine educating will go for naught. Such is the life of a projectionist.

Meter Action All-Important

Well, we had narrowed it down to one machine. We had done nearly everything to the darn thing that could be done easily without stopping the show. There was a third machine, but that was set up for magnascope, and we had no desire to change that, not without a struggle anyway. So we drew up a stool and sat down beside the offending amplifier to patiently watch the meter. Minutes went by. The needle did not even quiver. More minutes went by, and then some more.

My partner came over and said that maybe a resistor is going haywire. Boy, is he a big help? My pal! I glowered at him. He came back with: "I suppose a resistor couldn't be breaking down and causing the noise." I explained to him that it could, but was not very likely, as they were pretty good resistors. That held him for a while.

All this time my eyes were glued on the meter, and I was preparing to call it some appropriate names. I decided that the trouble was not there, but thought I had better stick a while longer. Wow! All of a sudden it kicked like a mule. What a relief. There it was. Yes, but *what?*

As much of the wiring, the suspension springs, *etc.*, was examined visually as we could get at. Everything OK. This would not necessarily have to be produced *in* the amplifier, so a little thought brings to mind the six-pole switch, fuses, and switches in the charging panel and batteries.

Can You Guess the Trouble?

Again watching the meter we wiggled the six-pole switch. Did the meter wiggle? I'll say it did. The contacts on the switch were then cleaned up and tightened, and the wires tightened under the terminals. More wiggling of the switch, but this time there was no movement of the meter. Satisfied that we had at last found the trouble we again relaxed. The night shift came in and we told them all about our troubles and how we fixed it.

Later on we heard that the noise was still there after we had gone. They knew what we had done, so they looked somewhere else for the devils in the system. There were the fader, various keys and switches in the speech circuits, and the Pec batteries.

Not very likely that the fader would be noisy. It had silver contacts and the center was pig-tailed; it had never given trouble since it had been fixed up this way. A pair of phones were put across the Pec batteries, and a wonderful assortment of scraping and scratching and popping came out. A new set of batteries fixed up everything. One of the old ones was defective.

PROJECTIONS

By *Frank Dudiak*

L. U. 239, Fairmont, West Virginia

THE new 6F6 pentode tube has an extremely high output in comparison with the older types. A single 6F6 delivers 5 watts with only 7% distortion, while two tubes in push-pull deliver 13 watts with only 5.5% total distortion. Overload characteristics extend over a wide range, but distortion increases in proportion to the overload. In this connection, it must be emphasized that to date there has not been an amplifying system that reproduces the original input with an incalculable degree of distortion.

- -

The electronic art has advanced to such an extent that a lie-recorder has been developed by Northwestern University. The machine takes simultaneous measurements of respiration, blood pressure, and perspiration of the patient.

- -

In the new W. E. 300A tube, which replaces the 242, the power consumption is much lower. Example: the filament consumption for the 242 is 32.5; in the 300 consumption is 6.0 watts. Wattage consumption has been decreased and the output increased by 3 watts.

- -

Does pitch depend upon the frequency of vibration? is another troublesome question. Offhand, one may answer this question negatively—which is incorrect. The greater the pitch the greater the number of frequencies per second, until the number of vibrations is approximately 16,000, representing the upper limit of the hearing sense. The lower limit is approximately 16 vibrations per second. Therefore, the greater the number of vibrations per second, the higher the pitch, and *vice versa.*

- -

Suprex arcs have been used for two years now and have occasioned much comment, both favorable and unfavorable. Our humble opinion includes both. The favorable points are: increased screen illumination per watt; more uniform illumination; ease of operation and maintenance, and less heat dissipation within the projection room. The unfavorable points are: difficulty in maintaining the crater image on the aperture; increased carbon consumption, and the precision required for adjustment and care of the carbon fed mechanism.

- -

Instead of devoting all of their time to the development of new types of lamps, lamp manufacturers should improve the present lamps and eliminate these undesirable characteristics. We know for a fact that it is dangerous to use Suprex lamps with projectors that are not equipped wih rear shutters. (Ed. Note: *Mr. Dudiak might elaborate on this last statement.*)

- -

Ideal reproduction balance requires that the product of the lower and upper frequency limits equal a value of approximately 400,000. This means that the reproduction range of 50 to 8,000 is more satisfactory than the range of 50 to 5,500, because the former equals 400,000, while the product of the latter is much less.

- -

Wave-length is found by dividing the number of frequencies into the velocity of sound. At zero Centigrade the velocity is 1090 feet per second, which increases 2 feet for each degree in rise of temperature. To convert from Centigrade to Fahrenheit scale, first multiply by 9/5, then add 32.

- -

The three effects of electric currents are: heat, magnetic fields, and chemical change. The most important of these, we think, is magnetic effect. Think it over.

- -

Add simile: as important as the assistant manager in the absence of the manager.

MOTIOGRAPH *means* "MODERN"

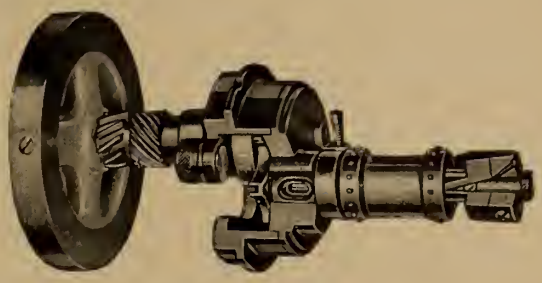
The very appearance of the New Model K Motiograph impresses one with the feeling of advanced design . . . close examination reveals feature after feature . . . each emphasizing modern engineering design, scientific selection of materials and precision manufacturing methods. The result is that Motiograph sets a new standard of performance on the screen which not only reflects itself in increased box-office receipts but also makes the projectionist's job easy, simple, and trouble-free.



$1090

PROJECTOR PRICE

COMPLETE, LESS LAMP AND SOUND REPRODUCER



UNIFIED INTERMITTENT DRIVE . . *for Steadiness*

Every projectionist likes to operate a machine that gives him a steady, flickerless picture on the screen. The reason for Motiograph's superiority in this respect lies in the simplicity and ruggedness of the intermittent movement. Study the photograph above. It shows the details of construction, and you will note that modern design has eliminated the usual intermittent gears. Because Motiograph's intermittent drive embodies a direct cam shaft there is no gear wear . . . no back lash . . . no jumpy picture. The hardened steel star gear and the correct engineering design of this intermittent unit reduces wear. Motiograph's intermittent movements, after years of continuous service, have been checked with a micrometer and show no measurable wear. Precision performance, uninterrupted service, and low maintenance cost are some of the factors responsible for Motiograph's popularity.

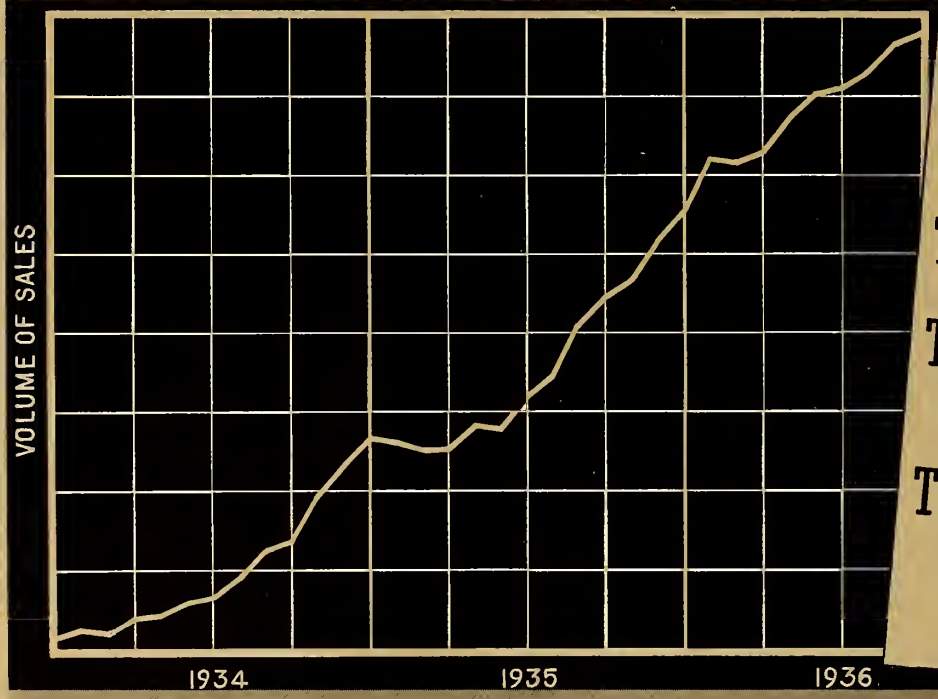
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THE WORLD'S FINEST PROJECTOR DESIGNED FOR ALL STANDARD SOUND EQUIPMENT

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NATIONAL SUPREX CARBONS



GIVE SATISFACTION

TO *Patrons*

TO *Projectionist*

TO *Management*

THIS IS SHOWN BY STEADY INCREASE IN VOLUME OF SALES

In Comparison With The Low Intensity Arc, The SUPREX ARC Gives:

- Whiter projection light
- 150 to 200 percent more screen illumination
- High permissible level of general illumination
- Greater clarity and depth in the projection of black and white productions
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PROVIDE PROJECTION THAT SATISFIES YOUR PATRONS—USE NATIONAL SUPREX CARBONS

All at no increase in cost

PER CANDLE POWER
PER UNIT OF SCREEN AREA

NATIONAL PROJECTOR CARBONS

NATIONAL CARBON COMPANY, INC.
Carbon Sales Division, Cleveland, Ohio
Unit of Union Carbide UCC and Carbon Corporation
BRANCH SALES OFFICES: NEW YORK - PITTSBURGH - CHICAGO - SAN FRANCISCO

COMMERCIAL TELEVISION: SOME OF THE REQUISITES FOR ITS SUCCESS

By *DR. ALFRED N. GOLDSMITH*
CONSULTING INDUSTRIAL ENGINEER, NEW YORK CITY

Television intrigues projectionists mainly because they fear its effect upon the business of exhibiting motion pictures. Popular interest in television, dormant for more than a year, has been revived by several recent occurrences, most of which formed a part of an extensive ballyhoo, which has no basis in any reasonable hope that television will become soon a flourishing industry. Projectionists as a group are interested in the answer to the question, "*how* soon?"

In May, 1935 I. P. was privileged to present the first basic contribution to the literature of television as a commercial undertaking[1], and it was this paper of historical importance which at once reassured the motion picture industry as to its future when television arrived and effectively riddled the preposterous claims advanced in behalf of television. Then, as now, is was Dr. A. N. Goldsmith who, drawing upon a wealth of personal experience in the electronic arts, delivered the *coup de grace* to those whose activities constituted a serious threat to the continued well-being of both the television and motion picture industries.

If the world-wide enthusiastic reception accorded the accompanying paper by leading personages in the radio broadcasting, motion picture, television and publishing industries is any indication, then I. P. is privileged to present an historic technical document—made more interesting to the motion picture industry because it is written from the inside viewpoint of a veteran radio broadcast engineer. Publication of this paper is made possible through the courtesy of the Radio Manufacturers' Association, before whom it was originally presented, and, naturally, of Dr. Goldsmith himself.—*Editor.*

WE IN the radio industry cannot assert that we have made no mistakes in the past; despite the fine growth of the industry and its genuine contribution to our national life, there has been much friction and lost motion. And now we face a complicated situation in the case of television broadcasting which seems to impend.

Shall we plunge wildly forward, substituting enthusiasm for analysis? Or shall we remain calm in our planning and activities, leaving the excitement to the persuasive advertisements of television receivers and programs, to the active salesmen, and to the delighted lookers and listeners in the home? With the past of radio in mind, shall we "try everything"—not once but twice? Or shall we do as little "muddling through" as it humanly possible?

[1]"Television and the Motion Picture Industry," p. 15.



Dr. Alfred N. Goldsmith

Commercial television broadcasting, to win general public acceptance and to enjoy a healthy growth, must be built on the basis of a group of necessary elements. These are a constructive Governmental attitude implemented by corresponding regulation; an active group of television broadcasting stations at least partly interconnected into national networks for program syndication; forward-looking program building organizations; careful engineering and manufacturing methods rendered effective by suitable merchandising practices and satisfactory servicing; an enthusiastic and numerous group of home lookers, and finally, a number of broadcast advertisers willing and able to secure the part-time attention of the home audience.

To just the extent that any of these elements are missing from the television picture, the day of widespread public acceptance of television-telephone broadcasting will be delayed and the success of the radio industry reduced.

It is encouraging to note that the Federal Communication Commission is evidently considering the needs of television broadcasting in an orderly and serious manner, and it is to be hoped that the decisions of the Commission in this field will be both generous and firm. To encourage the development of a new national industry is surely in accord with the spirit and needs of the times.

Intelligent Regulation Necessary

One of the problems under consideration is that of television standards. It is neither easy nor economic, under known methods, to change television receivers from adaptability to a certain transmission to adaptability to a different transmission standard. In this respect television differs markedly—and unfortunately—from telephony, and this factor cannot be neglected in planning for television acceptance. It becomes necessary, from the very commercial beginning, to establish standards which have every likelihood of being satisfactory to the public for a long period of years in order to avoid speedy obsolescence of these early television receivers in the higher price ranges with consequent general dissatisfaction and loss of confidence. This is one case where we must "aim high" regardless of inclination.

The criterion of any television service is its continuing entertainment value; and it is now the consensus of more informed opinion that this specification requires pictures having of the order of 400 lines or more. Particularly is this the case if the pictures are to be increased in size from their present modest dimensions: and we do not doubt that such an increase will in due course be found commercially feasible.

Another group of standards, in addition to the basic requirements of band width and ultra-high frequency allocations, deals with picture repetition rate, scanning method, aspect ratio, and synchronizing methods. Here again, the regulatory authorities will be well advised to require any essential uniformity even at the cost of some inconvenience to individual groups and in the interests of the general public.

The Commission will face the problem of allocating individual frequency bands

RECORD BREAKER

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EASTMAN *SUPER X*

PANCHROMATIC NEGATIVE

for television to particular organizations in certain localities. For example, the question may arise: to whom shall be assigned, upon application, the available ultra-high-frequency bands in a given city for use in television broadcasting? There may well be numerous claimants actuated by a wide variety of motives. Some will desire to carry out a scientific experiment; others a commercial venture. Some will be highly experienced in broadcasting; others may be ambitious newcomers seeking a meteoric career in the television field. Some will haxe extensive technical and program background; while others will lack interest in the engineering and entertainment aspects of station operation. Much wisdom and restraint will be required of any regulatory body which faces such decisions.

We may venture the general suggestions that television broadcasting allocations should be granted to those who are best qualified by parallel experience, by technical and other resources, and who are most likely in the long run to keep abreast of engineering and program progress and the most modern operating methods. It is not our belief that, on the average, television broadcasting could be better handled by those who have had no previous experience with telephone broadcasting than by those who have carried the burdens and enjoyed the privileges of our present broadcasting system for many years. Nor do we see any compelling considerations in favor of granting television broadcasting priorities to groups in the entertainment, news-disseminating, or advertising fields.

It is more reasonable to expect that the healthy development of television and the solution of its highly special problems will result from an independent broadcasting industry rather than from a group of by-product activities of other (and seemingly competitive) industries. Accordingly it is urged that, in a reasonable time, there be granted the necessary allocations to qualified applicants for local transmitting rights in the commercial television broadcasting field.

Program Cost 'Per Listener'

In developing television broadcasting, it is necessary dispassionately to consider the best way of reaching a multitude of homes with program material of continuing interest. On one side of the ledger—the expense side—we find the cost of the transmitting facilities and of their operation together with the cost of creating the programs and syndicating them. It is a truism that the more persons reached effectively by a given program of quality, the more justified that program and its cost then becomes and the more likely that there will be a continuance of programs of like quality.

We face then the dominant factor of the *program cost per listener*. This is the Sphinx at which every broadcaster thoughtfully stares, awaiting an answer to his question. When it is considered that qualified artists, authors, arrangers, and directors are relatively shy and rare birds found in few localities (and therefore purchasable only at a price) but that the audience is widely scattered, it again becomes evident that the only known way of reducing program-delivering cost per listener (which is another way of saying: increasing program quality per listener) is by program syndication.

We are not here discussing the relative merits of various methods of total or partial syndication of programs, such as transcriptions on wax or film, circulation of performers, wireline or coaxial-cable interconnection of stations, and connection by radio relay systems. Nor yet are we considering the commercial and administrative aspects of network operation. We wish only to emphasize that syndication is of the essence of high-quality and stable television broadcasting, and that it merits aid and support from all who are genuinely interested in the commercial success of that art.

Serious Interference Problem

Another nation-wide problem is that of avoidable man-made interference with radio reception. We have always had this electrical enigma facing us. An excellent beginning has been made in tackling this problem by the recently organized Sectional Committee on Radio-Electrical Coordination of the American Standards Association. But television broadcasting will be radiated in an unusually vulnerable region, namely, the ultra-high frequencies. Automobile ignition systems and similar sources can superimpose on the television picture the twinkling of a myriad of stars—an effect as startling as it is unwelcome.

There is a trend in some quarters to suggest legislation and resulting Commission action in the abatement of this trouble. One need not accept or reject this suggestion in making the statement that, in one way or another, interference with satisfactory television reception at reasonable signal levels and for proper home installations *must* be accomplished. The prophecy can also safely be made that it *will* be accomplished, since millions of embattled lookers (who happen also to be voters) will receive friendly consideration by prudent powers that be.

It is fortunate for television development that one of the ancient and popular fallacies of broadcasting—namely, the opposition to high-power so called in transmission—has largely had its day and been relegated in the main to the dust pile of forgotten errors. We can well remember the learned gentleman who, little more than a decade ago, hotly informed a gaping radio conference that no one needed a higher transmitting power than the half-kilowatt of his own station; and who justified this by stating that he had "national coverage" as evidenced in the form of letters from most states of the Union where listeners had heard his station!

Were this gentleman dead—which we are happy to say he is not—he would undoubtedly turn in his grave at the solemn proposal to limit the power of a certain class of broadcasting stations to *not less than* 50 kilowatts with the hope that 500 kilowatts will be widely used. Thus we may expect that powers of tens of kilowatts or more for television stations in the larger cities will be taken as a matter of course and wisely regarded as the boon to good service which such stations actually are. In this regard, at

(*Continued on page* 27)

RCA Improves Television Image Size and Quality

THE 10th anniversary of National Broadcasting Co. was the occasion for the unwrapping of RCA's latest television demonstration in N. Y. City. Guests saw a black-and-white image 7½ by 10 inches, as contrasted with the previous standard size of 5¼ x 7 inches. Pictures on both the smaller and larger screens were best in closeups. In these, however, there was no clear definition of features, yet there was no difficulty in recognizing the person televised. It was largely the shadings that were absent. Some of the pictures were blurred. In pictures taken at a distance, as in some of the scenes flashed from the current Pathe Newsreel, the characters were not recognizable.

Pictures shown from film were clearer than those picked up by the television camera, though it was maintained that the television camera will be able to project pictures as plainly as does film. In televising a scene three cameras are used, one for closeups, another for short range and a third for distance. It will be necessary to eliminate the jump in the screen picture caused by the shift from one camera to another.

Increase Image to 441 Lines

RCA will increase the 343-line definition film to 441 lines, which will make the pictures plainer. Meanwhile, they expect to be able to maintain a uniform speed for the electrons and thereby eliminate blurring. Atmospheric static has no effect on television, and RCA expects to be able to eliminate man-made static. A new movie technique would be necessary for television films because distance shots cannot be used.

M. G. SETS *VS.* RECTIFIERS FOR CARBON ARC SUPPLY

By *JOHN H. HERTNER*
HERTNER ELECTRIC COMPANY, CLEVELAND

FOREWORD: Readers of I. P. have followed closely the series of articles which have appeared in these columns from time to time relating to the comparative merits of rectifiers (both tube and copper-oxide types) and motor-generators as efficient sources of power supply for the Suprex carbon arc. Contributors to this series were Messrs. J. H. Hertner and C. C. Dash, of Hertner Electric Co., and Mr. J. K. Elderkin of Forest Electric Corp.

A report by Mr. Dash of data collected during comparative tests of various types of power supply equipments induced a reply by Mr. Elderkin in which were included the following assertions:

1. Meters are materially affected by magnetic flux. Rectifiers have a considerable magnetic field, and if the test meters used were not outside this field, their readings could not be relied upon.

2. The efficiency of most rectifiers, particularly the tube type, increases materially as the output is increased up to full capacity.

3. The resistance of an open arc varies continuously, due to changes in gas generated and differences in greater temperature and arc spacing—which cause variations in current demand. Such variations, however, are not the result of rectifier deficiencies. The substitution as a load of a resistance, instead of the arc, would show that the resistance would not vary in value suddenly—thus supporting the contention that such variations as are present are induced by the arc itself.

The appended article by Mr. John Hertner is an interesting commentary on both Mr. Dash's original contribution and the reply thereto by Mr. Elderkin.

WHAT was done was to read the meters in the usual manner and then turn them through 180°, noting whether the reading changed with the same load. The sameness of the load was checked by a second meter located at a distance. No change was perceptible, and apparently no stray field effect was encountered. This we can prove because we still have the rectifier.

The statement made by myself as to a higher efficiency at three-quarter load than at full load is a general one and was aimed not at rectifiers particularly but at a large group of apparatus whose duty cycle is such that a higher average or "all-day" efficiency is attained by designing in this manner. It was brought in because of the statement by Mr. Elderkin that, since Mr. Dash had spoken of a higher efficiency at 40 amperes than at 50, he, Mr. Dash, assumed that the efficiency at 1 or 2 amperes would approximate 100 per cent.

Various Load Efficiencies

I felt that we had equal license to carry the same reasoning in the contrary direction and state that, since Mr. Elderkin claims a higher efficiency at 50 than at 40 amperes, it should approximate 100 per cent at some point of overload.

Everyone does *not* know that transformers increase in efficiency with increase of load, contrary to Mr. Elderkin's opinion. I have before me an electrical handbook giving listings of transformers and their performances. On these the three-quarter load efficiencies are almost invariably higher than full load; in fact, some of the half-load points are higher than full load.

There are service transformers which in most cases operate at a load of so low an average value that operating expense is considerably less if a point below full load is favored.

What the exact characteristics of rectifier tubes may be I do not know; but reference to the *General Electric Review*, issues of March to November, 1933, discloses a series of articles covering the subject. Incidentally, efficiency curves shown there indicate a decided drop beyond a point of maximum efficiency which is far below the ampere-capacity of the tube.

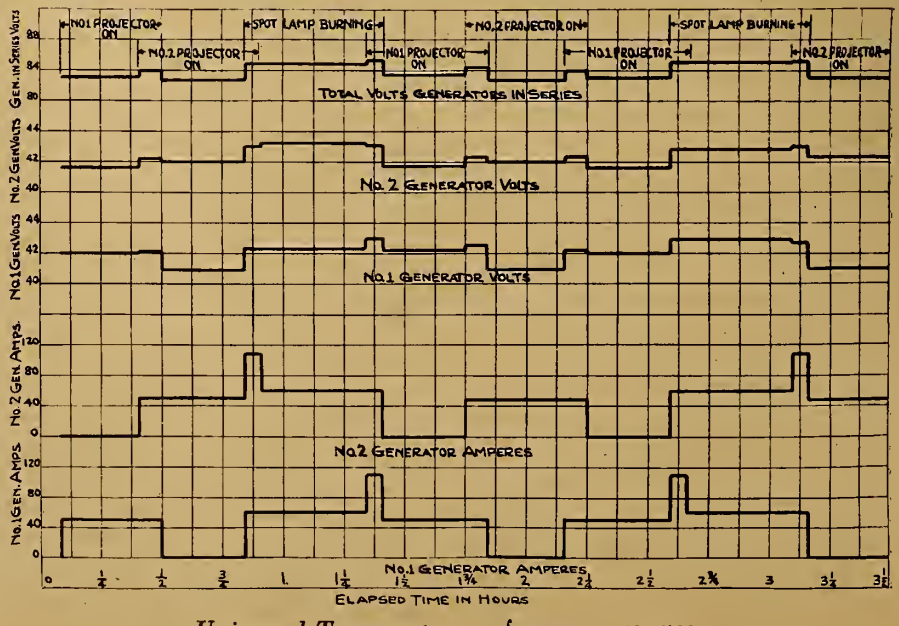
In a recent issue of the same publication for May 1936, is an article covering the copper-oxide rectifier. A set of curves is shown illustrating aging where a maximum of 60% efficiency is developed on normal load, an efficiency of 50% on twice normal, both on new elements; a maximum of 48% at about 60% normal, and of 25% at double normal after a period of aging. This information is on page 245 and is the work of Mr. E. A. Harty. We believe it will be admitted that the General Electric laboratory has done a considerable amount of research work covering the subject and that its findings are worthy of consideration.

I do not discredit Mr. Elderkin's arithmetic. In this he is perfect. But I do believe he is not as familiar as he might be with tubes, copper-oxide elements, and transformers.

We all reverence Ohm's Law. It states that current is volts divided by resistance. Resistance is defined as being proportional to length and inversely proportional to the cross-section of a given material. Ohm's Law is an expression of a very general and fundamental truth that results are proportional to the action of cause or force working against and overcoming opposition or resistance.

The arc has resistance, but its resist-

(*Continued at foot of next page*)



Universal Transverter performance curves

Five Recent Fire Deaths Stress Poor Equipment and Lax Regulation

By *JAMES J. FINN*

FIVE projectionists in as many widely scattered states of this otherwise glorious Union have died in projection room fires during the past ninety days. Ninety divided by five is eighteen. Not a bad average, this—especially for an industry that prides itself on the comfort and peace and relaxation and opportunity for escape from dreary reality that it provides daily for the "masses" of this world.

Masses! The word somehow sticks in one's mind. Maybe this industry of ours that disdains anything less than superlatives must have mass killings, due to its own delinquencies, before it comes out from behind the smoke screen of glamour and romance laid down by high-powered publicity and reveals its true raiment of false front and ballyhoo.

No, indeed, eighteen is not a bad average; but how many times eighteen were affected by the death of those five? And how many more times eighteen must be sacrificed to the inanities of an industry the superficialities of which are so apparent as to be unbelievable?

Where Responsibility Lies

Handing out large doses of the truth is an expensive luxury; but from the truth there is no escape—even for the motion picture industry. The merchandising of pictures through the so-called projection process is tied in with a few statistics other than box-office receipts. The man kicked by a horse is not interested in statistics that show a decline in such accidents during the last fifteen years.

When we say "industry" we mean *everybody* in this business—not excluding Unions. Somebody is responsible for these five lives which were sacrificed unnecessarily. And we mean *unnecessarily*.

Where, then, lies the responsibility? What shall be done about it?

The underlying causes of these five fires are unknown, as usual. But it is known (how explicit the evidence) that in each case there was a projection room fire. Now, the dearly beloved statistics of the actuarial addicts prove that projection room fires usually happen in one or more of three ways: (1) carelessness (2) defective film or (3) defective equipment.

Admittedly, carelessness is an important factor; but it just isn't in the cards that all five of the doomed men were sprawled in chairs and reading newspapers while sipping fine old brandy when the black hour struck.

But it is very probable that in some or all of those whirring projectors that would shortly deal out death were running strips of film, already run to death, the physical condition of which was a disgrace to the industry that handled it. Unfortunately, the film usually is burned to nothingness—along with the body.

And it is very probable that the projector mechanism through which the film was running constituted the perfect testimonial, not to the business sense of the world's fifth largest industry, but to the craftsmanship of those who designed and built it so many years ago—a mechanism that had not had added to it in many years even a new sprocket.

Who is to blame? The answer to this question is contained in the appended statements, the responsibility for which is assumed by the writer:

1. There are no projection standards in this industry. Standards is merely a word which provides a few hours discussion and diversion for those groups who presumably are interested in the advancement of the projection process.

2. Regulation by politically-constituted bodies, by the National Board of Fire Underwriters and every other such body in America, without exception, is even funnier than the U. S. House of Representatives. There just isn't any effective regulation. It's the prize joke of the age—apart from its tragic consequencies.

3. Ninety-nine and three-quarter per cent of American theatre owners and managers know no more about the projection process, or the equipment used therein or the maintenance requisites thereof than a blind man knows about color.

4. Insofar as decent working conditions and proper safeguards for the man who exposes himself to constant danger every moment he is in the projection room are concerned, craft leadership is bankrupt. Most of them are too busy giving and attending festive functions (five funerals certainly warrant no fiestas), or telling all and sundry how much money "their men" get for so-and-so many hours a week. Craft interest in anything but wage scales is practically non-existent; those few places where a lively interest in craft welfare still is visible serve only to emphasize the short-

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ance is not a direct function of length. In the case of Suprex carbons an arc of 45 amperes with 7 and 6 mm. carbons had a length of ¼" approximately at 31 volts, and about ⅜" at 36½ volts. This means that an increase of 50 per cent in length results in an increase of but 18 per cent in arc voltage while 45 amperes are maintained. To be severely critical of these results the objector could argue that the arc stream could widen with the longer arc and hence could in part nullify the effect of increasing length and still follow Ohm's Law. However, the arc apparently does not follow such a course.

Mr. Elderkin errs when he speaks of Mr. Dash laying all arc variations to line fluctuation. Anyone can see plenty of arc fluctuations where the source is a generator with constant voltage. The S.M.P.E. paper by Joy and Downes of several years back explains this. Such variations, as Mr. Elderkin correctly surmises, are due to changes in the effective resistance of the arc.

Mr. Dash does want, however, to emphasize the presence of other fluctuations in line voltage; and from our observations in the field, they have been the cause of a number of generator sales. The thought he wished to convey is that a 10 per cent change in line voltage means about the same percentage in d.c. voltage from the rectifier; while the output voltage of the generator is scarcely affected. A 10 per cent in voltage change means erratic behavior of the arc and usually a considerable change in its current.

Accompanying this article is a graph which gives performance curves for the Hertner Transverter under conditions as to time and load as are indicated thereon.

comings of the overwhelming majority of towns where the phrase "projection standards" is only a banquet term.

5. Fifty per cent of the organized projectionists in America are working in projection rooms which couldn't qualify as third-rate lavatories. A lavatory requires some degree of ventilation. Naturally, the heavy-voiced and big-chested craft leaders never heard of tuberculosis or any other pulmonary ailments.

60% of Theatres Below Par

6. Sixty per cent of American theatres are operating with defective equipment—constituting a definite hazard to the safety of millions of moviegoers—without interference from regulatory bodies which are either too corrupt or too stupid to discharge their proper duties. Consider the effect on the box-office if this fact were generally known.

7. The Hollywood horde of "stars," producing "geniuses" and technical "wizards" might just as well confine themselves to making strictly Class D pictures, because when pictures are finally merchandised (?) through projection they are so mangled in the process that they barely attain that ranking. It really is to laugh, all this guff about motion pictures as an art form.

8. Cecil D. deMille, one of movieland's distinguished directors, is authority for the statement that fifty (50) per cent of the theatres in America have deficient projection. Of course, Mr. deMille had time to visit only the key spots.

The writer has never approved of yelling "fire!" as a scare-all for obtaining efficient projection, whether the consideration be that of ample manpower or of acceptable equipment. The craft is not in the business of selling fire extinguishers; its only merchandise is good projection. It seems, however, that five projection room fires resulting fatally constitute ample reason for a shift in viewpoint.

The introduction of the 2000-foot reel as an industry standard has just been accomplished. Significantly, almost all those craft units that lent it ready acceptance were those that had long since ceased to make any pretense of retaining good working conditions. Still, in all the thousands of explanatory words that acquainted the industry with the 101 advantages of the longer reel, there was neither uttered nor written a single sentence testifying to the rat-trap character of the equipment through which these 2000-foot film lengths were to run.

Hollywood prates about its magnificent technical achievements—its beautiful photography, its splendid film stocks, its great laboratory work which utilizes every known aid for turning out a good print. All of these might just as well be dispensed with, because they mean absolutely nothing when run through the junk heaps which exhibition people have the temerity to call projectors. The writer is surprised that the projectionist death rate from room fires isn't many times its prevent level.

No consideration has been given herein to the fact that the projection of pictures with such equipment is nothing short of downright dishonesty and a deliberate steal from the paying patron.

Prospects for Improvement

What's to be done about it? The solution of this problem, while extremely difficult, is not impossible. The producers themselves could help mightily, of course, by establishing and insisting upon minimum standards for equipment through which their film runs. But they won't. Although heartily in favor of higher standards, the distributors will do nothing that might ruffle even slightly the feathers of their exhibitor customers.

An appeal to exhibitors for improved equipment as a straightaway, common-sense business proposition is too fantastic to warrant discussion, in the light of the record of numerous past failures along this line. Mr. Exhibitor will adhere to only such minimum standards as are rigidly enforced.

Regulator bodies are in need of a thorough overhauling to induce a changed perspective insofar as projection equipment requisites are concerned. The establishment of minimum standards for *all* room equipment, not alone projectors, aimed at the subsequent official approval of important regulatory bodies, is the most important task now confronting those groups whose goal is the elevation of equipment standards and improved operating practices.

Finally, and most important of all in this situation, are the projectionist units themselves. Unions simply must give attention not only to "how much" but also to the conditions under which their members earn their wages. The shortcomings of the organized craft in this respect constitute a most unpleasant chapter in organization history. Nobody has yet improved upon the following notice, signed by the entire crew, to a theatre manager:

Mr. Manager:

Repeated requests for overhaul of our projectors having been denied, and needed parts not having been forthcoming, the entire projection crew of this theatre hereby serves notice upon you that, until such requests are granted, we shall not be responsible for inferior screen results or for any untoward incident which may develop as a result of the continuing use of the aforementioned defective equipment.

A copy of this notice is being forwarded to our Local Union office.

Any of the aforementioned groups could exert a powerful influence in improving conditions. Any two acting in concert could actually clean up the situation. Surely it should not require five more funerals to impress upon all those concerned the extreme urgency of corrective action.

CHRISTMAS SEALS—AND THE UNCEASING WAR ON THE DREADED 'WHITE PLAGUE'

Each year at this time it is our privilege and pleasure, if not our duty in behalf of the craft, to open our pages to the advertising and editorial copy of the National Tuberculosis Association, which wages an unceasing war on tuberculosis. Association activities are financed through the sales of Christmas Seals, a tiny bit of colored paper that is slowly but surely conquering tuberculosis. High hopes are entertained for the ultimate eradication of this dread scourge of mankind—provided more widespread support is given to the Christmas Seal.

Pulmonary ailments are a definite occupational hazard of projection work—and many members of the craft have benefitted by the Association's activities. Therefore, we owe it to ourselves, at least, to extend the meager aid asked by the Association—the purchase of Christmas Seals.—J.J.F.

YOUR chances for dying from tuberculosis were about four times as great some 30 years ago as they are today. Thus you have today gained a security from tuberculosis such as the world has never before known.

Thirty years ago 200 out of every 100.000 people living in the United States were dying every year from tuberculosis. If you go back another 30 years the number is more than 300, or three out of every 1,000 people who lived and worked in the days of your mothers and fathers! No wonder Oliver Wendell Holmes called it "The White Plague"! Today not many more than 50 people are dying from this disease yearly in each 100,000. Still a large number, to be sure, but small by way of comparison with figures of a generation or two ago.

Thirty Years' Progress

Thirty years ago the estimated number of living persons in the United States who had tuberculosis was approximately 1,500,000. Today there is less than one-half that number of living victims of this disease in this country. When it is realized that every victim of tuberculosis is a potential spreader of tuberculosis to an average of three others, the chances of "catching" the disease today as compared with 30 years ago are very

much less. Here is increased security indeed.

You, Mr. Taxpayer, and you, Mr. Citizen, have helped the National, state, and local tuberculosis associations to buy this security from tuberculosis for your state and community. For through your support, hospitals and other institutions have been built in every state of the Union, some 1,200 in all with 95,000 beds for the care of tuberculosis victims. You have by your taxes helped to build these institutions and you are helping to maintain them. And there are today more than 1,000 clinics, and 10,000 public health nurses, besides a great army of doctors, social workers, and other persons and agencies, all of whom are working with and for you to shield you and your family from tuberculosis.

Good Results Not Accidental

But this happy result has not been brought about by accident. Thirty years ago the first tuberculosis Christmas Seal in the United States was sold in Wilmington, Del. That little holiday sticker made possible the formation of hundreds of tuberculosis associations, today 1,981, and these groups of citizens working patiently day after day have made you and millions like you realize that health can be bought.

The proceeds from the Christmas Seal sales for 30 years would be relatively insignificant, when compared with a year's expenditures by the federal government, for example. And yet they have helped to give you and yours a security from tuberculosis that is of inestimable value.

Tuberculosis still is one of our greatest, and in many communities our greatest, health hazard. It still takes a toll of almost 70,000 lives annually. It still numbers its living victims by more than 500,000, and it still causes loss of life and health that costs our country at least three-quarters of a billion dollars a year.

Professional men—such as lawyers, physicians, technical engineers—have about 28 deaths a year from tuberculosis for each 100,000 males in the group; while unskilled workers such as servants, teamsters and laborers of various types have 183 deaths in each 100,000 employed. In other words, the mortality in the lowest economic group is six and one-half times that in the highest economic group. And from the doctors, the lawyers and engineers the rate of death *rises steadily* as wages, income and assurance of a job *decrease*, clerks showing a rate of 62, skilled workers 74, and semi-skilled men, 98.

And yet tuberculosis is not generally considered as an industrial disease. With the exception of hard dust, there are few processes in industry that have a specific influence on the course of this disease. Nevertheless, studies made from large groups of workers indicate that between three and four out of every 100 show evidence of tuberculosis.

In a large insurance company analysis of the medical records of 14,054 employees showed that 3.51 of the men and 3.36 of the women out of each 100 had evidence of tuberculosis. And this is an industry where work is almost entirely of a clerical nature and where an exceptionally rigid examination for tuberculosis and other disease is given prior to admission to the company. In fact, out of 17,947 applicants for work with this company, 1.03 per cent were excluded because of tuberculosis.

Twenty years ago a diagnosis of tuberculosis usually meant premature death or chronic invalidism and dependency. At that time half of the patients improved on discharge from the sanatorium, at home six months to two years, were worse or had died. No longer need this be true. We have read: "Tuberculosis is preventable—it may be cured."

We have enough scientific knowledge to bring this "White Plague" under control, if not to eradicate it. To do this requires the education of many millions of people, in order to get them to do their part in ridding the country of tuberculosis. For this purpose the tuberculosis associations of the United States —local, state, and National—appeal to you to buy Christmas Seals this year.

NEOBEAM OSCILLOSCOPE: WHAT IT IS AND HOW IT APPLIES TO PROJECTION

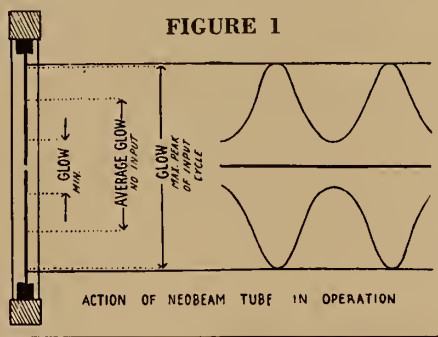
By *E. V. SUNDT*
SUNDT ENGINEERING COMPANY, CHICAGO

The introduction of numerous adjuncts to the projection process, particularly with respect to sound reproduction, makes essential the expansion of I. P.'s editorial content so as to enable its readers to familiarize themselves with newly-developed equipment. Most interesting is the appended article anent the oscilloscope—a new instrument exploiting a new principle, highly sensitive yet extremely simple, and a valuable addition to every projection room.—*Editor.*

CONSIDERABLE attention has been given to gaseous tube oscilloscopes in the last year and while the basic principles are not new, some of the recent developments are. The essential part of one of these oscilloscopes is the tube itself, and an understanding of the principles of gaseous discharge tubes is necessary.

Gaseous discharge tubes are roughly divided into two classes—direct discharge tubes and glow tubes. In the direct-discharge type the conduction of current is directly between electrodes and through the ionized rareified gas; a neon sign is an example. In the glow-type the direct discharge is usually limited by design as much as possible and the discharge is confined to a glow on the electrodes only. The familiar glow lamp is an example. The gaseous oscilloscope tube belongs to the glow type.

FIGURE 1



ACTION OF NEOBEAM TUBE IN OPERATION

Going back to 1861 we find Feddersen discovered the area of glow covering the electrode of a gaseous discharge tube was directly proportional to current passing through the tube. It had been discovered earlier than this that only the negative electrode glows. In 1904 Gehrke and Disselhorst combined these two principles to produce an oscilloscope by using a tube with elongated electrodes and a rotating mirror to scan the electrodes across them. Since only the negative electrode glows, on a.c. the glow shifts from one electrode to the other at a rate equal to the impressed frequency. The same setup has been used recently to check modulation in amateur transmitting.

The early type gaseous tube oscilloscope has several inherent disadvantages. In the first place, the easily ionized rare gases were practically unknown and nitrogen was usually used as a medium. The high ionizing potential of nitrogen limited the use of the instrument to the observation of relatively high potentials, such as condenser discharges. Even



FIGURE 2

with neon or the other rare gases, the lowest practical striking voltage obtainable is about 200 volts d.c. and about 10 mils are required to operate the tube at full cathode glow. These values are entirely too high for practical use as an all around oscilloscope.

Advantages of Modern Unit

In the new Neobeam oscilloscope this difficulty has been overcome in a unique manner. Instead of making the electrodes glow directly from the input voltage, a 6L6 beam power radio-frequency oscillator is provided to keep *both* the electrodes *glowing all the time.* This changes the entire picture: the disadvantage of high striking voltage is eliminated; but more than that, an amplifier and modulator may then be used to modulate the oscillator, which in turn causes the glow on the electrodes to rise and fall in direct proportion to the input to the amplifier.

Viewed in a scanning mirror an image is shown like Fig. 1. The tube is essentially the same design as formerly used and is comparatively small, 6″ long by 9/16″ dia. The elongated electrodes measure 2″ each, thus permitting a 4-inch image. Distortion in the input is portrayed by changes in the wave outline. Thus, instead of 200 volts and 10 mils minimum to operate the tube, we use inputs of as low as 1 microvolt across an input potentiometer of 1 megohm and obtain 100% modulation.

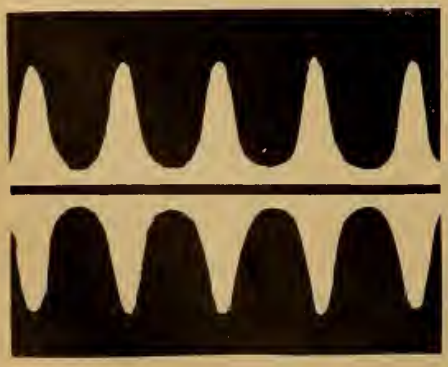


FIGURE 4

By means of a built-in multiplier switch the range is extended to 200 volts. The number of applications for the instrument by these methods are greatly extended. The finished instrument and an internal view are shown in Figs. 2 and 3, respectively.

Since the upper limit of frequency response of a gaseous oscilloscope tube is about 10,000 cycles, the use of the Neobeam is in the range below these frequencies. The scanning mirror is driven by a constant speed induction motor with an adjustable friction-disc clutch. The speed of scanning is calibrated directly in R.P.M., an especially useful feature in making quick frequency determinations. Frequency is determined by the simple formula $f = \frac{R.P.M.}{L2}$; where f = frequency, R.P.M. = sweep, and L = distance between cycle peaks in inches (see Fig. 4). To facilitate measurements the image is observed through a screen calibrated in ¼-inch spaces.

In demonstrating wave-form it is often

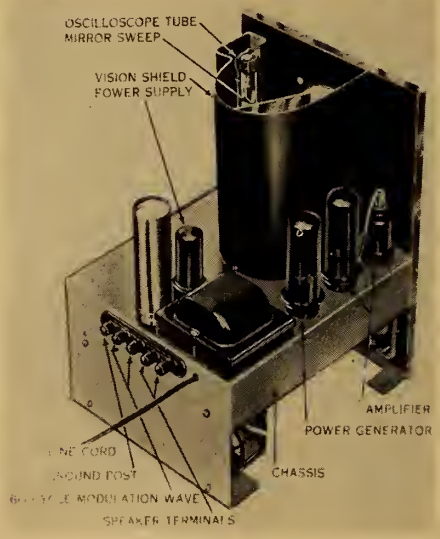


FIGURE 3

desirable to hear as well as see the input signal. For this purpose a speaker connection is provided (see Fig. 3). With the speaker connected the instrument becomes in effect a small public address system capable of direct input from a crystal microphone on the input and a 5-watt speaker on the output. While this feature has its uses in making demonstrations, its greatest usefulness lies in the fact that distortion can be shown visually that would be impossible to detect audibly. A very practical use lies in demonstrating and comparing the fidelity of different equipments with the same signal input. In teaching work it is used to show the effect of timbre on tones of similar pitch. This outlet also provides a connection for self-recording

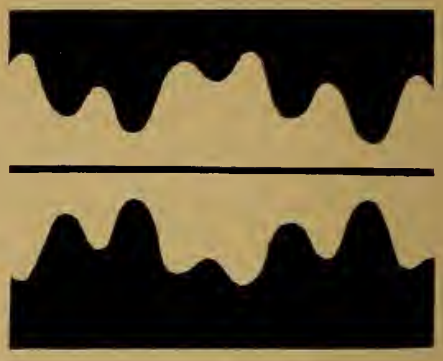


FIGURE 5

equipment. Another outlet of 60 cycles is provided for checking purposes.

The input signal is fed into a resistance shunt and potentiometer arrangement to permit inputs from 1/1,000,000th volt to 200 volts.

The first amplifier stage is a 6J7 high-gain amplifier with the constants set to secure the highest possible gain and still retain linear amplification characteristics. The modulator is one of the new 6L6 beam power tubes and the oscillator is also the same type. The oscillator is set at 100 K.C. and serves to keep the oscilloscope tube constantly ionized.

The pattern shown by the Neobeam is the modulated wave type—that is, each half cycle is shown double symmetrically about the zero axis. Thus a sine wave is shown as in Fig. 1. Changes in wave-form are shown by the outline, and a 320-cycle complex wave is shown in Fig. 5.

Many and Varied Uses

The uses of this type of oscilloscope are far too many and varied to cover in this article. While it does not have the high-frequency response of the cathode-ray oscillograph, its great simplicity and good response to audio frequencies opens fields for its use by non-technical laymen who could not operate the more complex forms of oscilloscopes. Being ideally suited for demonstrations of how sound waves look, it is used for portraying sound and electrical wave form. In combination with the speaker attachment it demonstrates the principle of frequency, amplitude and timbre visually and audibly in a way hardly possible by any other means and with relatively low cost equipment.

In radio broadcasting it is used for checking modulation, excitation, line levels, amplifier gain feedback and for tuning. In radio servicing work it is used for balancing receivers, hum tracing, checking distortion, and fidelity. In motion picture work it is used for checking and servicing sound equipment as well as theatre acoustics.

[NOTE: A schematic diagram of this oscilloscope, showing all components and their connections, is available to any subscriber upon request to I. P.]

THE W. E. 91-A AMPLIFIER, UNIT OF THE 'MIRROPHONIC' SYSTEM

By *AARON NADELL*

This latest Erpi amplifier is one of the most significant technical developments since the introduction of sound-picture reproducing equipment. Frequency distortion was eliminated sometime ago; but there remained the much more serious problem of harmonic distortion to frustrate all efforts to attain natural sound reproduction.

This 91-A amplifier, through the medium of what is termed a "harmonic suppressor," accomplishes what is substantially complete elimination of harmonic distortion—an advance which is of the utmost importance and one which should have the closest attention of progressive projectionists who wish to keep abreast of latest advances in the art.—*Editor.*

THIS amplifier (Fig. 1) is used in Western Electric Mirrophonic systems for the smaller theatre. It contains a number of features making for better tone quality and greater ease of operation that are entirely new to the theatre field. Among these are:

1. Reverse feedback. Those projectionists who have not yet heard of reverse feedback will, in the future.

2. Single end output stage. The final tube of this amplifier feeds the loud speakers and, because of reverse feedback, delivers better quality than can be obtained with conventional push-pull output. This is explained in detail subsequently.

3. Plate current meter calibrated in percentage instead of in milliamperes.

Power Input Circuit

Line a.c. enters the 91 amplifier at the jack, J-3, shown toward the lower right, and completes its circuit through switch D-2 and the primary winding of the power transformer T-3. The line of dashes in the primary of that transformer indicates merely that the draftsman has not elected to draw in all the turns. There is nothing unusual in the transformer itself.

Four secondaries are shown. The one at the extreme left, labelled "A," supplies current to the heaters of tubes V-1 and V-2. The heater terminals of these tubes are similarly labelled, but the connecting lines are omitted from the drawing in accordance with modern practice. The next secondary from the left, marked "B," heats the filament of the output tube. V-3. The third secondary from the left provides plate power to the rectifier tube, V-4; and the fourth secondary heats the filament of that tube.

The full-wave rectifier circuit is conventional. The rectifier filament constitutes the positive terminal of the d.c. output, and the center tap of the plate transformer the negative terminal.

From the positive terminal, the rectifier tube filament, trace upward to jack J-2 out through the monitor speaker field and back in at the bottom terminal of that jack and thence down a bit to a line that runs left all the way across the drawing. We shall henceforth consider that line the positive bus of the power circuits of this amplifier. From the negative d.c. terminal, the center tap of the plate secondary of the power transformer, trace straight up past R-26, C-12, C-11 and R-22, and then turn left with another line that runs all the way across the drawing. That line we shall hereafter consider the negative bus.

One of the uncommon features of this amplifier is the rectifier filter shown just above the rectifier tube, V-4. It consists merely of bleeder resistors and condensers of very large capacitance, the only inductance in that circuit being the field winding of the monitor.

A familiar point in consideration of such filters may be reviewed at this time, both for its own sake and also because it may serve as an example to be used later on, when examining the reverse feedback arrangements.

The output of the rectifier tube is, of course, d.c., since electrons can flow in only one direction within that tube, namely, from filament to plate. There is no alteration in the direction of the output current flow, and there cannot be any. The output drawn from the rectifier consists of unsteady, or fluctuating, d.c. only.

However, it is customary to speak of an a.c. component in the output of rectifier circuits, inasmuch as d.c. with a ripple in it acts exactly like steady d.c. upon which an a.c. component has been superimposed. A circuit carrying such current may be treated in every respect as though it contained both a.c. and d.c.; and in fact the filter condensers, C-10, C-11, C-12 and C-13 charge and discharge in rhythm with the ripple, current reversing its direction of flow in the plates of those condensers and in the wires leading to those plates.

The simplest, most convenient and most useful way of looking at a circuit of this kind is to consider that (although current can flow in only direction through the rectifier tube) the output drawn from that tube contains both a.c. and d.c. components.

In looking into the reverse feedback arrangements of this amplifier, later on, it will be found that a certain type of distortion created by the action of any amplifying tube can be considered most simply, conveniently and usefully by saying that the tube acts as a generator to produce spurious frequencies of sound current.

In this rectifier circuit the condensers are of such values that the a.c. component is effectively short-circuited (or, if one prefers a different terminology) the ripple is very effectively absorbed by the charge and discharge of the condensers.

Plate Power Circuits

From the positive bus of this circuit (the return from the monitor field) trace up through the primary of the output transformer, T-2, to the plate of V-3. Continuing left along the positive bus trace down through R-6, left and up through R-14, and left to the plate of V-2. Continuing left along the positive bus, trace down through R-15 and left and up to the screen grid of V-2.

Further left along that bus to the left of V-2 a line leads down through another resistor labelled R-6, left through still another labelled R-6, left through an R-5; up, right, up through R-4 and left to the plate of V-1. Still further left along the bus, turn down through R-20, left, up through R-2, and thence to the screen grid of V-1.

The return to negative for all of these circuits is through the cathodes of V-1 and V-2, and through the filament of V-3.

From the filament of V-3 ("B") back to the mid-tap of transformer secondary

●

Figure 1 of this article appears on the second page following.

"B" (connections not shown in drawing) and from that center tap up, left, right through R-28 and R-21, and down to the center-tap of the plate secondary, which is the negative terminal. R-28 and R-21 are the grid bias resistors for V-3, and R-28 serves further, as will be seen, in the operation of the plate current meter that is calibrated in percentage.

From the cathode of V-2 trace down through R-12 and R-13 to the negative bus which, as seen previously, returns to the center-tap of the power transformer plate secondary. These resistors provide control grid bias for V-2, and R-13 is further associated with the action of that same plate current meter. From the cathode of V-1 trace down, left, and down to the negative bus. R-1 is the grid bias resistor. The meter does not read the plate current of this tube.

Follow the positive bus left as far as possible, and then down through R-20, left, and down to the top prong of the input jack, J-1. From that prong an external line runs to the two soundheads. The return is through ground to the right-hand terminals of J-1, which are joined to the amplifier negative bus.

Plate Current Meter

The plate current meter calibrated in percentage is shown as a circle surrounding the letter "A," and labelled M-1. This meter is close to the center of the drawing. A short distance to the left of it will be found the single-pole, double-throw switch, J-1, by means of which this meter reads the plate currents of either V-2 or V-3, as desired.

Now, these tubes are not the same, but, as the drawing shows, one is a pentode and one a triode and their plate currents are not the same. Conventionally, meter M-1 would have two scales, and the projectionist would be obliged to note down or remember the correct reading in milliamperes for each tube. In this case, however, the memory work is done by the circuits of the amplifier.

The right-hand terminal of the meter may be traced to the right and up to the negative bus. The left-hand terminal may be traced left to the blade of the switch. If the meter is to read V-2 plate current, the switch is thrown upward. The meter actually serves as a voltmeter reading the voltage-drop across R-13, which is 23.1 ohms, and part of the grid bias resistance of V-2. All the plate current of V-2 flows through R-13, and the value of that resistance in ohms is so chosen that the meter reads just 100% when the correct value of plate d.c. passes through it.

If the switch is thrown downward, the meter reads the voltage-drop across R-21, 0.64 ohms. This unit is part of the grid bias resistor of V-3. The value of that resistor has been so chosen that when the correct plate current for V-3 is flowing through it the meter needle shows 100%.

In other words, this plate current meter is actually a voltmeter, reading voltage-drop across resistors through which flow the plate currents to be measured. Since these resistors can be given any desired value in ohms (less than the total resistance desired for grid bias) it is readily possible to obtain the same meter deflection for two different plate currents, each of which is correct for its own tube, and to get the same percentage of change in meter reading if either current is more or less than it should be.

Grid Bias Circuits

The resistors that supply bias to the control grids have been inspected in the course of tracing the plate circuit. The plate d.c. of V-1 returns to negative through R-1, 2,000 ohms, in series with the cathode of that tube. The cathode is then positive, with reference to ground, by the extent of the voltage-drop across R-1. The control grid of that tube connects to ground as follows: up, left, down through the secondary of the input transformer, T-1; right, down, left, and down to the negative bus. The cathode of V-1 is therefore positive with reference to the control grid, or, which is the same thing, the control grid is negative with reference to cathode, by the extent of the voltage-drop in R-1.

R-12 and R-13, in series, serve the same purpose in the case of V-2. The control grid of that tube may be traced to ground, up, left, and down through R-9. That grid is negative with reference to its cathode by the extent of the potential difference across R-12 and R-13. The fact that when the meter switch is thrown upward the meter shunts R-13, is of no importance, since the meter is of much higher resistance than the resistor and has no influence whatever on the bias of V-2.

The plate d.c. of V-3 returns to negative through the filament, thence to the "B" filament winding of the power transformer, and from the center-tap of that winding up, left, up and right through R-28 and R-21. The grid of that tube is traced to negative through R-18 and R-19, and is negative with respect to filament by the extent of the voltage-drop in R-28 and R-29.

The Speech Circuits

The resistances in series with the grids of course have no effect on the grid bias, since no d.c. flows in them; as far as d.c. is concerned there is no potential difference across them, and from the point of view of grid bias they may be considered merely as wires connecting the grids to ground. The same is true of the secondary winding of T-1.

Speech input enters Fig. 1 at the extreme left, through the left-hand terminals of jack J-1. A pair of leads run upward from those terminals to the input transformer primary. A loop around those leads, just above J-1, shows that they are shielded and that the shielding (like the loop) is connected to ground.

From the secondary of the transformer speech a.c. is impressed across the control grid and cathode of V-1, directly to the grid, and to the cathode through C-1 condenser.

Regarding the plate and cathode of V-1 as the poles of a generator of amplified speech a.c., trace from the plate up and left, down through the lead, R-4; down, left and down through the left hand C-4 condenser; left as far as possible; up, left, up and left through C-1 to cathode. There is of course a parallel return through the source of plate supply; but the resistors R-5, R-6 (10,000 ohms) and the other R-6 (15,000 ohms) act in association with the easy path for a.c. provided by C-8 to confine the plate a.c. of V-1 to C-8, and thus effectively "decouple" the speech current of that tube from the speech currents of V-2 and V-3.

Still another lead in parallel to R-4 may be traced as follows: from the upper end of R-4 up and right through C-7 to control grid of V-2. From the lower end of R-4 down through C-4 to the negative bus, right past R-25 and then up, and right through C-6 to the cathode of V-2. The amplified speech current derived from V-1 is thus impressed across the control grid and cathode of V-2.

The speech output of V-2 may be traced from the plate of that tube right and down through the plate load, R-14; down through C-5 to the negative bus, left along that bus to the point between R-13 and R-25, and up and right through C-6 to V-2 cathode. The easy path for a.c. provided by C-5, in association with the decoupling resistor R-6 shown to the right and above it, effectively decouples this circuit from the source of plate supply.

From the upper end of R-14 trace up and right through C-3 to the grid of V-3. From the filament of V-3 trace to the center tap of the corresponding filament secondary of the power transformer, and thence up, left, up and right through C-5; up, left along the negative bus and up through C-5 to the lower end of R-14. The alternating voltage-drop developed across R-14 by the speech output of V-2 is impressed across the grid and filament of V-3.

The speech output from V-3 flows through the primary of the output transformer, thence to the right along the positive bus, down through C-8 and C-9 to the negative bus; left, down past R-22;

left through C-5, down to the center tap of V-3 filament secondary, and thence to the filament of the tube.

The terminals "GR. WH" and "GR" of the primary of T-2 are not used in this circuit. The center-tapped secondary winding is connected, through the three upper terminals of J-3, to the frequency dividing network of the speaker circuit.

Reverse Feedback Circuit

A second load upon the output of V-3, in parallel to the primary of the output transformer, may be traced as follows:

From the plate of V-3 up, left through R-29 and R-17, through C-3, and left and down to the screen grid of V-1. From the cathode of V-1 to the negative bus through C-1, as previously traced, and from the negative bus, down and left through C-5 (16 mfd.), as previously traced, to the filament secondary of V-3. This is the reverse feedback circuit.

Inspection of this circuit merely with reference to the parts included in it indicates that the speech power is fed back to the screen grid of V-1 in phase with the control grid speech a.c. of that tube; but in fact those two grids are 180 degrees out of phase by virtue of the values chosen for C-7, C-3 (0.04 mfd.); C-3 (2 mfd.), and the resistors associated with them. If the two grids were actually in phase, this circuit would produce common or regenerative feedback instead of reverse or degenerative feedback.

The former type of feedback is familiar to projectionists with radio experience, also to all who have used a microphone and placed it too near a loud speaker. The feedback of Fig. 1 is novel in that it is "reverse," 180 degrees out of step with the input voltage.

When the control grid of V-1 swings positive, increasing plate current, the screen grid of the same tube swings negative, offsetting the increase, not altogether, but to the extent determined by the impedance of R-17, R-29 and C-3 (2 mfd.). When the control grid of V-1 swings more negative, decreasing plate current, the screen or accelerator grid becomes more positive and tends to counteract the effect. One overall result is that the total volume output of the amplifier is considerably lowered. Another is that harmonic distortion is drastically reduced.

Harmonic Distortion

In the ordinary action of an amplifying tube, any tube, when the control grid voltage is changed by an input signal, the plate current changes proportionately. However, the proportion of plate current change to grid voltage change is not constant, but only nearly constant. Suppose, (to take round numbers) the control grid charge changes by one volt, and the plate current increases one milliampere in response. Then if the control grid swing continues until it reaches two volts, the plate swing will not be two mils, but possibly 1.9 or something of that order.

In other words, the "straight line" portion of the characteristic curve of a tube is not entirely straight; there is a little curvature in it. The pattern of the output speech a.c. does not duplicate the pattern of the input speech a.c. exactly. Some degree of distortion is introduced by the action and the nature of the tube.

Now, in the case of the more familiar rectifier and filter, it was noted that although the fluctuating current drawn from the rectifier tube could not possibly flow in more than one direction, it might be regarded as containing a.c. as well as d.c.—not only theoretically but for every practical purpose. For example, it was seen that when condensers are associated with wires carrying such current, a real reversal in the direction of current flow could be obtained in the plates of such condensers and in the wires leading to them.

In the same way, the slightly distorted pattern of speech a.c. produced by any amplifying tube, as just described, may be regarded as if the distorted pattern consisted of the original sound wave (amplified of course) plus a number of other frequencies associated with it. This holds true practically as well as theoretically. Just as in the case of the rectifier filter, in which condensers can draw a.c. from a line that contains current moving in one direction only, so in the case of this type of distortion, suitable filters can draw from the distorted output supplementary frequencies that were never present in the original input.

These frequencies are called *harmonics*, and the type of distortion here referred to is called *harmonic distortion*. It is measured in per cent. An amplifier is said to have so-and-so many per cent harmonic distortion, and this is one method of indicating its quality. The harmonic distortion, or harmonic content of an amplifier is measured, in practice, by using suitable circuits to separate the original or fundamental frequency from all the others (just as in the case of the rectifier the filter sepa-

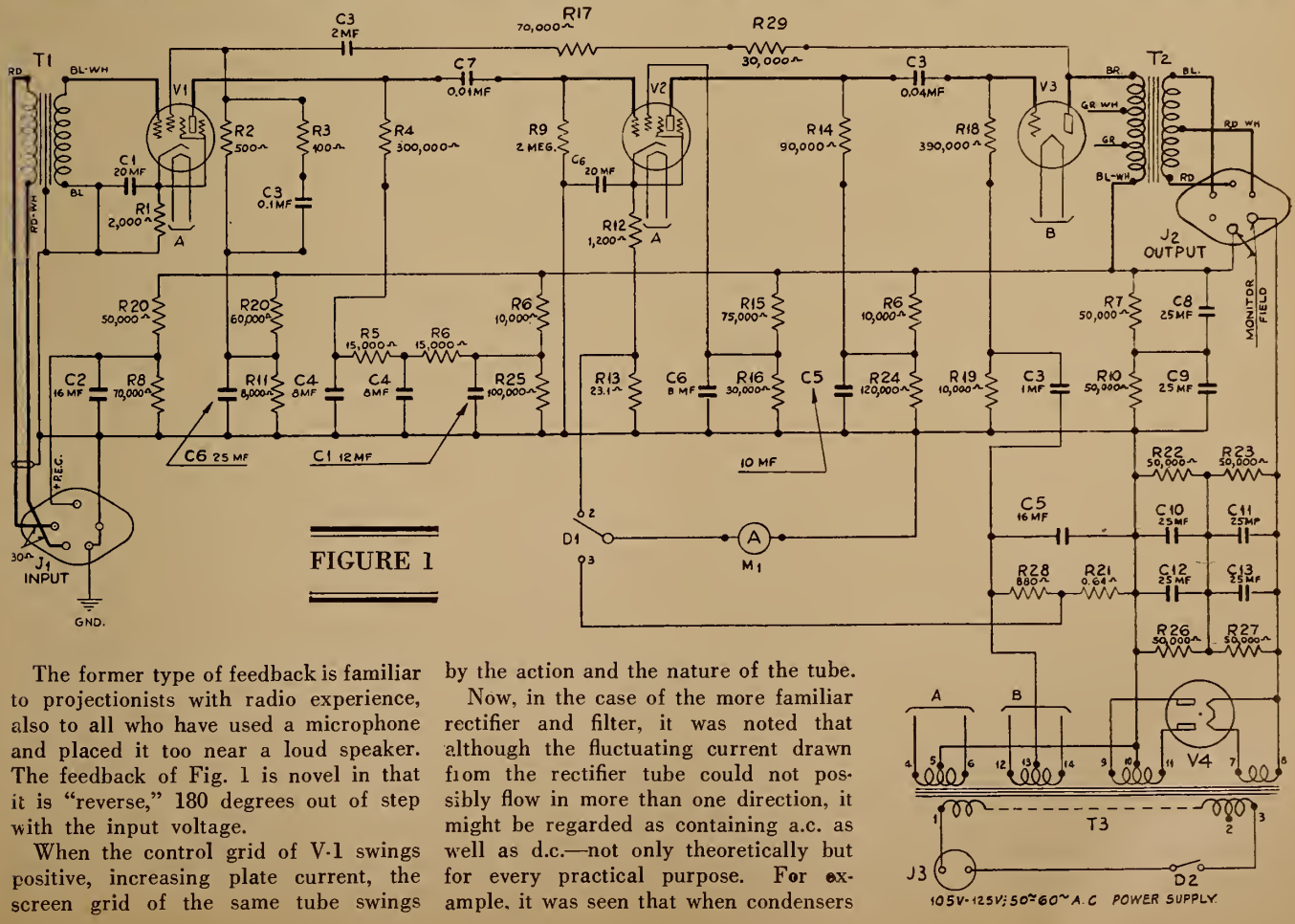


FIGURE 1

rates the a.c. and d.c. components) and then measuring the harmonic voltages separately.

In standard amplifier circuits, a push-pull output stage improves quality because the second and other "even order" harmonics meet in the primary winding of the output transformer 180 degrees out of phase, and cancel each other. Third and other "odd order" harmonics are in phase in the primary winding of the output transformer and do not cancel, but go on to the loudspeakers. They are heard as a form of distortion not easy to identify by ear, but having the effect of an unnatural quality in the sound.

Now in the circuit of Fig. 1 the harmonic distortion as well as the fundamental output in the plate circuit of V-3 is fed back, in part, to the screen grid of V-1, 180 degrees out of phase with the control grid of that tube. So far as the fundamental is concerned, the effect is merely to reduce volume. So far as the harmonic content is concerned, the effect is to introduce into the amplifier the identical harmonic content, 180 degrees out of phase. In so far as the design of the feedback circuit can maintain a precise balance of phase and volume, the harmonic content, even order and odd order both, is cancelled entirely, and no harmonic distortion at all appears in the speakers.

Scanning Compensator

To compensate for losses in scanning which occur at the higher frequencies even with the best possible focus, a high-frequency compensator has been introduced into the reverse feedback circuit. In tracing that circuit it was seen that the screen grid and cathode of V-1 are coupled across the output of V-3, and form part of the a.c. load upon that tube. But there is still another parallel load. Just right of V-1 is R-2, and right of that R-3. From the screen grid of V-1 trace up, right, down and right to the upper end of R-3; thence down through C-3, left, down through C-6 to the negative bus, and back to the cathode of V-1.

Through this circuit some of the high-frequency feedback is by-passed around the screen grid and cathode of V-1. Consequently, the overall reduction in volume resulting from reverse feedback is somewhat reduced at the higher frequencies; in other words the h.-f. response of the amplifier is increased, the circuit that accomplishes that result being included in the reverse feedback circuit.

NOTES *from the* SUPPLY FIELD

★

A NEW portable projector arc lamp designed so that it may be supplied with the various controls and systems required for use with either 35 mm. or 16 mm. film is announced by Strong Electric Corp., Toledo, Ohio. To be known as the Strong Junior High, it is 22″ long, 12″ wide and 14″ high, which is larger than the Strong Portable but smaller than the Utility series. It is 6¾″ high from the base of the optical center.

Screen brilliance equal to that attained with regular theatre equipment is provided when supplied with either high- or low-intensity burner for use with 35 mm. film. When used with 16 mm. film the Junior High is supplied as a high-intensity arc which permits projection of a theatre-size picture and a snow-white light having eight times the brilliancy of incandescent light.

The arc control is built as an integral part of the lamp, which has been designed for simplicity of operation as it usually will be used by lay projectionists. The Junior High is equipped with arc imagers, ammeter, automatic pilot light, manual controls and an inside dowser system.

RCA INDIANAPOLIS PLANT

Substantial increases in the sale of RCA motion picture sound equipment has necessitated the opening of a new and larger manufacturing plant in Indianapolis. RCA manufacturing facilities in Camden, N. J., have been greatly taxed this year by a 100% increase in theatre installations of Photophone sound reproducers. The signing of recording license agreements recently with several major motion picture producing companies has also been a large factor in the expansion move.

Efficient coordination of the engineering and manufacturing divisions is assured by the establishment of a complete engineering staff in Indianapolis.

DE VRY REEL RECOMMENDED

The new DeVry clock-spring steel reel lengths is recommended for use with the 2000-foot film lengths now standard in the projection field. The outstanding feature of this new reel is its indestructability, with even the hardest usage (including repeated jumping upon it) failing to disturb its perfect alignment. This new DeVry reel can be threaded in the dark, so cleverly arranged is the slot, over which the film need only be drawn in order to catch tightly. It has replaceable sections, although the need for this feature is difficult to understand in view of the indestructability of the reel.

G. E. MAN TO COAST

H. W. Hale, automotive products field representative for General Electric, has been transferred from the Boston office to the San Francisco office. He will be responsible for sales and service of tungar chargers and copper-oxide rectifiers for motion picture machine projectors.

APPROVE NEUMADE CABINET FOR DOUBLE REELS

A new Sealtite film cabinet, designed for use in storing the new double reels in theatre projection rooms, is announced by Neumade Products Corp., 427 W. 42nd St., N. Y. City. This cabinet has fixed capacities for five, six, eight, ten and twelve reels, with a double-walled compartment for each reel, and is of heavy metal construction. The compartments are closed by gravity, the reel being about half surrounded with a permanent metal container attached to a vertical door, which has a full hand grip.

Formal approval of this cabinet has been given by numerous city inspection bureaus, including Chicago.

NEW UNIT ELIMINATES THE MOTOR CONTROL BOX

Elimination of the motor control box on theatre reproducing systems is accomplished through the use of a constant-speed, condenser-type motor now being distributed by Co-operative Sound Service Supply Co., 3315 Olive St., St. Louis, Mo. The motor (110 v. A. C., 60-cycle. single-phase, 1200 r.p.m.) has a key number of DR-429-C and is warranted to give complete satisfaction. Other sound projection units, notably for power supply, are made by this company, headed by Clyde Weston, well-known I. A. man.

MAZDA PRICE REDUCTIONS

Further price reductions on several Mazda projection lamps used in portable motion picture projectors have been announced. New prices are 10 per cent below previous prices and 25 per cent below introductory prices. Lamps and classes of service affected include the standard-voltage, 100-watt and 200-watt T-8 bulb lamps with bayonet base, for 8-mm. and slide-film projectors; the standard-voltage, 400-watt and 500-watt T-10 bulb and 750-watt T-12 bulb biplane-filament lamps with medium base, for 16-mm. projectors; and the standard-voltage, 1000-watt short T-20 bulb biplane-filament lamp with medium base, for 35-mm. projectors.

S. O. S. CORP. NEW ADDRESS

S. O. S. Corp., handling a complete line of visual and sound projection equipment and general theatre accessories, has taken a long-term lease on new and larger quarters in 622 11th Ave., N. Y. City. Change effective in January.

SOME HAZARDOUS PROPERTIES OF MOTION PICTURE FILM

By *A. H. NUCKOLLS AND A. F. MATSON*
UNDERWRITERS' LABORATORIES, CHICAGO

MANY cellulose nitrate film fires and explosions in the past involving loss of life and damage to property have been thoroughly investigated by underwriters and others in order to devise measures to control this hazard. Through the combined efforts of the National Board of Fire Underwriters, the National Fire Protection Association, and manufacturers of cellulose nitrate, regulations governing the handling and storage of inflammable film have been worked out and have been in use for many years. This paper will discuss some of the hazardous properties of cellulose nitrate film and also the cellulose acetate (slow-burning type) film.

In handling and storing nitrocellulose, or, chemically speaking, cellulose nitrate, film, the danger is due to the unusually low temperature of ignition or decomposition of the film, its extremely rapid rate of combustion, and the fact that it can decompose (exothermic), even in a restricted supply of air or oxygen, with the evolution of explosive and poisonous gases.

Many combustible substances with which we are familiar, such as wood and paper, when heated rapidly do not ignite until a temperature in the neighborhood of 600 or 700°F. is reached. Cellulose nitrate decomposes when exposed to temperatures in the neighborhood of 300°F. On prolonged exposure decomposition of nitrate film may occur at temperatures as low as 230°F.

Some Common Danger Points

The temperature of ordinary incandescent lights, steam pipes, as well as that of lighted cigarettes and matches, exceeds 300°F., and such sources of heat may therefore ignite the film. Hence, in handling and storing cellulose nitrate film, it is of great importance not to have any portion of the film near steam pipes, incandescent lights, or any source of heat.

Everyone is familiar with the fact that the chemical reaction known as combustion is accompanied by the evolution of heat. The amount of heat developed by the combustion of a unit mass of a given substance is known as the heat of combustion. The heat of combustion of a given substance is always the same if the conditions of the chemical reaction are the same, regardless of whether the combustion takes place slowly, or rapidly, or occurs in air or in pure oxygen.

The introduction of the 2000-foot reel as an industry standard has focussed attention upon the hazards incident to the handling of cellulose nitrate film. For their own protection, if nothing else, projectionists should understand thoroughly the dangers inherent in their daily work.

The hazards in handling or storing cellulose nitrate motion picture film are due to the unusually low temperature of ignition of the film, the extremely rapid rate of combustion, and the possibility of its decomposing (exothermic) even in a restricted supply of air (oxygen), with the evolution of explosive and poisonous gases.

The appended paper, originally presented before the S.M.P.E.,† gives data in respect to the hazardous properties of both cellulose nitrate and cellulose acetate (so-called slow-burning film), with which every projectionist should be familiar.—*Editor.*

The difference of temperature that is noticed between the slow and the rapid combustion of substances depends primarily upon the length of time during which the heat of combustion is evolved. In the absence of other factors affecting the result, we may regard the temperature as depending upon the quantity of heat evolved in unit time.

The heat of combustion of nitrocellulose is about the same as that of wood, being six to eight thousand BTU's per pound; but the *rate* of combustion of nitrocellulose is from 12 *to* 18 *times that of wood in the same form.* It will be evident, therefore, that the temperature attained by the combustion of cellulose nitrate is extremely high as compared with that of other substances commonly met in practice. Film fires are therefore very difficult to control, and may cause considerable damage within a very short time.

Most of the products with which we are familiar are formed from their elements or elementary substances with evolution of heat, and therefore during decomposition absorb heat. Cellulose nitrate is formed from elementary substances with *absorption* of heat, therefore upon decomposing into simpler compounds evolves heat so that the process after once starting tends to maintain and accelerate itself.

Under practical conditions the decomposition of cellulose nitrate may or may not be accompanied by combustion, depending upon the conditions, particularly as to the air supply. When stored in vaults and other closed places where the supply of air is restricted, decomposition of large quantities of film may occur within a relatively short time.

When cellulose nitrate film burns freely in an excess of air the gases evolved are carbon dioxide, nitrogen, and water vapor, none of which is poisonous.

Gases Evolved by Nitrate

When cellulose nitrate film burns or decomposes (with or without production of flame) in a restricted supply of air, as would be the case in a closet or vault, carbon monoxide (CO), nitrogen dioxide (NO_2), and nitrogen tetroxide (N_2O_4) are evolved. Other gases such as hydrogen, methane, and traces or negligible amounts of hydrocyanic acid gas—and, in the case of undeveloped film, traces of hydrobromic acid—are also evolved. Under ordinary room conditions 1 pound of cellulose nitrate film yields about 4 to 5 cu. ft. of these gases, which, of course, expand as the temperature rises, according to the well known gas law.

The proportions of carbon monoxide, oxides of nitrogen, and hydrogen evolved depend in a measure upon the conditions, but the poisonous oxides of nitrogen and carbon monoxide are always produced by the decomposition of nitrate film in dangerous quantity under conditions likely to be met in practice. When the decomposition of the film takes place under pressure, as may be the case in a closed vessel or vault not provided with vents, hydrogen gas is evolved in considerable quantity.

It will be noted that when carbon monoxide or when hydrogen gas is evolved under conditions where the supply of air is not sufficient to cause their immediate

(*Continued on page* 25)

†Journal of the S.M.P.E., Vol. XXVII (Dec., 1936) No. 6, p. 657.

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

PROSPECTS for settlement of the disturbed labor conditions in the N. Y. City theatre field were enhanced recently through an agreement between L. U. 306, affiliate of the I. A., and the Independent Theatre Owners Assoc., members of which have been using non-A. F. of L. projectionists for 4 years. Tentative plans call for the absorption by 306 of about 120 Allied Union men, plus 100 members of the Empire Union.

Impetus for the final settlement was supplied by Mayor F. H. La Guardia, who, following a series of bombing outrages, served notice upon both the unions and the theatre owners to either "get together" or have the theatres closed. Amalgamation would run the 306 membership over the 2,000 mark from its present roll of 1,800.

Settlement will involve another one of those 10-year contract things, the style for which was set in the 306-major circuit settlement of Sept., 1935. Provision for "arbitration" of wage scales every two years is an outstanding feature of the agreement. Basic wage scales have not yet been agreed upon. Both Allied and Empire unions have not a few unemployed today, to which must be added the 250 unemployed of L. U. 306, whose "working" members even now get only 4 or 5 days a week. The final setup will include more than 300 unemployed, with no indication as to their disposition.

Announcement of a 25% wage increase for all I. T. O. A.-affiliated theatres is less significant than it appears, since most of these houses have been using only one man per shift, as compared with 306's two-men standard. It appears that a weekly wage of about $35 per man is the best that can be expected after all arrangements are made. Details of the final settlement will be reported later.

Double-Track Film General Within Year, Says RCA Head

The use of double-track (so-called push-pull) recording and reproduction will be more or less general in this country within the next 15 months, according to a statement by E. M. Hartley, manager of RCA Photophone, in reply to an inquiry by Allied States Exhibitors Assoc. Pointing out that Loew's Theatres already are being equipped for double-track film, the use of which may be general throughout the circuit within a few months, Hartley's letter continued:

"Both Western Electric and RCA systems are being built so that film can be interchanged, and, furthermore, the systems are being so designed that they can be modified to play either single or double track film regardless of whether they are RCA or W.E. recorded.

"All of our new recording channels now being installed in the three major lots in Hollywood will have provisions for recording either single or double track. It is quite likely that within the next 12 or 15 months many of the theatres in this country will be using double-track film in preference to single track."

'Electrics' Report Advances

To date, thirty-four installations of RCA High Fidelity equipment have been made for Warner Theatres since the first trial installation a few months ago.

Orders have just been given Erpi to completely modernize the Universal Pictures sound department with the new Mirrophonic recording equipment. Plans include conversion of all sound recording apparatus to push-pull recording.

Watkins Heads N. Y. Assoc.; Utica's 25th Anniversary

Claude Watkins of Albany is the new president of the N. Y. State Association of Motion Picture Projectionists, his election taking place at the Utica convention on Nov. 18. Other officers chosen were Melvin Denny, Syracuse; W. W. Byrne, New York, and Fred Boekhout, Rochester, vice presidents, and Harry Brooks, Troy, secretary-treasurer. Glenn Humphrey, Utica; Earl Tuttle, Binghamton; Robert C. Griffin, Cortland; Cal Bornkessel, Rochester, and Denny were appointed members of the legislative committee.

Charles Skinner, Utica; Paul Shay, Elmira; Robert Leonard, Watertown; John Meany, Syracuse, and Watkins were elected to the executive board. The next meeting will be held in Rochester on June 12.

Utica L. U. 337 was host to the N. Y. State Assoc. delegates at a banquet on the 18th, which date marked the 25th anniversary of this organization. Among the speakers was J. J. Finn.

Industry Income Up Sharply

A substantial increase in theatre attendance is producing profits for motion picture companies well above the level of the corresponding period of last year. *Poor's Industry and Investment Survey* points out that business at theatres is running 10% to 20% above this time in 1935, and that the large producing organizations with theatre chains are receiving substantially larger box office returns. Furthermore income from film rentals, which is based on a percentage of gross receipts, is climbing steadily.

"It is estimated that the gross income of large chains is up at least 10%," continues the report. "And since expenses do not rise in direct proportion to increases in volume. approximately 70% of gross gains is being converted into net income.

"Improvement in the quality of motion picture entertainment explains in a measure the better results. But in the final analysis, the higher theatre attendance and motion picture earning power traces to the increases in consumer incomes caused by steady progress toward national prosperity.

Hearst Name off Newsreel; Now 'News of the Day'

The Hearst name has been eliminated from all releases of Hearst Metrotone News, present issues bearing the title of "News of the Day," distributed by M-G-M. Widespread dissatisfaction with the red-baiting, militaristic tone of Hearst newspapers, plus their vicious attacks upon President Roosevelt during the past year, evidently occasioned no little concern anent the goodwill of theatres showing the Hearst tag on newsreels.

Eastman-Technicolor Pact

Eastman Kodak Co. and Technicolor, Inc., have entered into a contract which will bring these two companies more closely together in the field of research and development work for motion pictures in color. The two companies have been operating heretofore under a cross-licensing agreement, and the new arrangement is described as a further forward step in the same direction.

'It Can't Happen to Me'

Joseph Kuriger, projectionist at the Palace Theatre, in Jackson, Miss., was burned to death in a projection room fire which started from a film explosion. To prevent the spread of the flames to the auditorium, Kuriger locked the exits from the room and shut the ports, thus saving 150 people from possible death or injury. He was burned so badly that he died within a short time from his wounds.

One theatrical paper referred to Kuriger as having "stole the show." This certainly is a great "show"—of the shortcomings of inspection and regulation in the motion picture exhibition field.

HAZARDOUS PROPERTIES OF MOTION PICTURE FILM

(*Continued from page* 23)

combustion, *a potential explosion hazard is introduced,* inasmuch as these gases may be ignited later when they reach a supply of air (oxygen).

Water Serves Double Purpose

It is generally believed that fire-extinguishing systems employing water serve only to extinguish or control film fires; but as a matter of fact, the application of water to decomposing film serves a double purpose, inasmuch as the water reacts chemically with the poisonous oxides of nitrogen, reducing them to nitric acid, which is soluble in water. In a well-sprinkled room in which films are stored, the bulk of the poisonous oxides of nitrogen evolved by decomposition of the film would be chemically acted upon and dissolved by the water. Unfortunately, the poisonous carbon monoxide gas is only slightly soluble in water and can not be effectively removed by this means.

It is apparent from the foregoing considerations that when cellulose nitrate motion picture film is used, adequate provision should be made for its safe handling and storage, having in mind the low ignition and decomposition temperature of the film, its extremely rapid rate of combustion, and the possibility of its decomposing with the evolution of explosive and poisonous gases. The importance of complying with the regulations of the National Board can not be overestimated.

Film having a cellulose acetate base was first submitted to the Laboratories about 20 years ago; and as a result of an extensive investigation, acetate-base film in the form of ribbon for motion pictures was listed as slow-burning, the fire hazard being somewhat less than that of common newsprint paper in the same form and quantity. This type of film, however, did not come into general use immediately, probably on account of the superior qualities of the cellulose nitrate film for photographic purposes. Recently, however, the manufacturers of acetate film have succeeded in improving its qualities to a marked degree, and this type of film is now quite generally used, particularly in projectors of the non-professional or miniature type, which may be operated in public without a standard booth if the slow-burning acetate film is used.

The ignition temperature of cellulose acetate is between 700 and 800°F, as compared with about 300°F for cellulose nitrate. A temperature of about 500°F is required to produce decomposition of cellulose acetate film. In the neighborhood of this temperature the evolution of fumes occurs.

Cellulose Acetate Characteristics

The decomposition of cellulose acetate film, however, is not exothermic, as is the case with cellulose nitrate. In other words, the decomposition of cellulose acetate film once started does not continue except under conditions where

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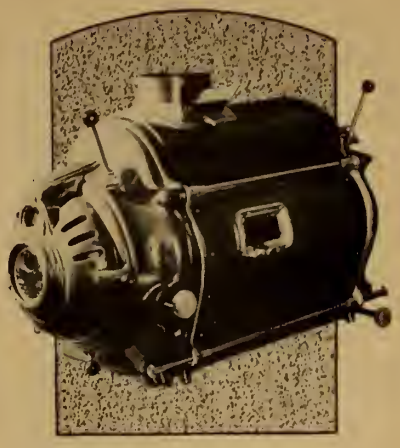
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there is an external source of heat. It will be noted that in the case of cellulose nitrate film the decomposition continues when once started, even in the absence of an external source of heat. This difference between the decomposition of cellulose nitrate film and that of cellulose acetate film is therefore of great importance from the fire and life hazard standpoint.

The cellulose acetate film continues to burn when once ignited if the supply of air is sufficient to support combustion freely. The combustion, however, will cease in a restricted supply of air. The rate of combustion of cellulose acetate film is relatively slow, and the amount of heat evolved is of a low order, being much less than that evolved by paper or wood.

Storage of Acetate Film

Under practical storage conditions the acetate film will, in case of fire, be subjected to combustion in a more or less restricted supply of air (oxygen). In this event the combustion will be accompanied by some decomposition. Under such conditions most of the hydrogen, methane, and carbon monoxide will undergo oxidation or combustion, but sufficient quantities of carbon monoxide (about 1 per cent) may be evolved to render the air surrounding the fire, particularly in a closed room, dangerous to breathe, as would the combustion of paper under similar conditions.

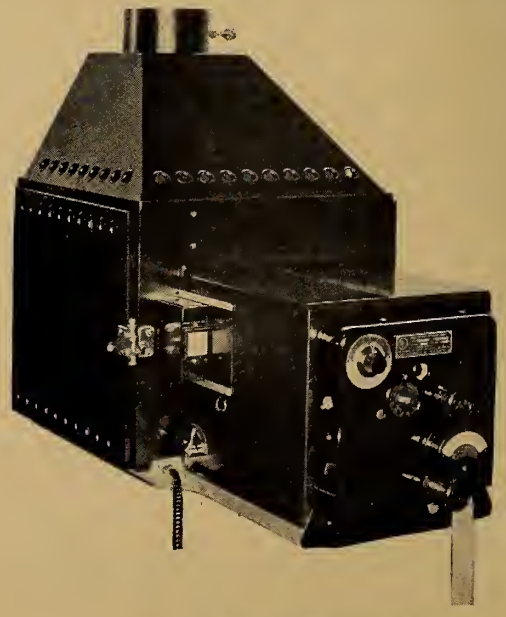
The acetic acid fumes, aldehydes, and ketones are irritating and suffocating, but are not comparable in their poisonous effects to the *deadly oxides of nitrogen* evolved by decomposition of *nitrate film.*

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TELEVISION: REQUISITES FOR ITS SUCCESS

(*Continued from page* 13)

least, the Commission inherits a well-ploughed and fertile field.

The second necessary element for television success is a group of well-constructed and capably managed transmitting stations with a suitable measure of interconnection for program syndication. It is thus incumbent on the present-day broadcasters and networks to take up the burden of establishing the necessary facilities. Only by so doing can they hope to assume that position in the future television set-up to which they appear normally entitled. That television will come can hardly be doubted. If it does not come through an expansion of the facilities of those now engaged in telephone broadcasting, it will come through the enterprise of others—and, as we have previously indicated, this is not in our opinion a desirable process of evolution so far as a healthy and normal growth of television is concerned.

The manufacturers of transmitting equipment will also do well to remember that the initial impressions of the public will largely depend on the quality of the transmissions, and that the best that can be produced will probably be none too good. Let there be no casual or careless transmitter production for television, in the interest of the entire industry.

We have noticed with some concern what is, in the last analysis, an occasional and largely meaningless friction between the so-called local stations and the networks. As well might the hand object to the arm. Networks and outlet stations are an organic unit, and each equally needs the other. The growth of cordial relations within the broadcasting groups is greatly to be desired; and we feel fairly confident that common sense will triumph to that effect.

NO ONE can long study television broadcasting without becoming somewhat concerned as to the mode of program-department organization and the subsequent production of the necessary program material. On any reasonable standard of appearance and performance, it is clear that there are not available in clamoring throngs the necessary regiments of satisfactory performing artists for the new field. The stage and screen have preempted (at substantial cost) those who are judged most worthy of winning public favor through their appearance and performance. In the radio field, performance only (and that in the

One sure blessing stemming from the widespread interest in color reproduction is that it will make the lamp manufacturers and optical people go to work in earnest in trying to unravel the problem of more and better light. From this nothing but good can accrue to the projection process generally.

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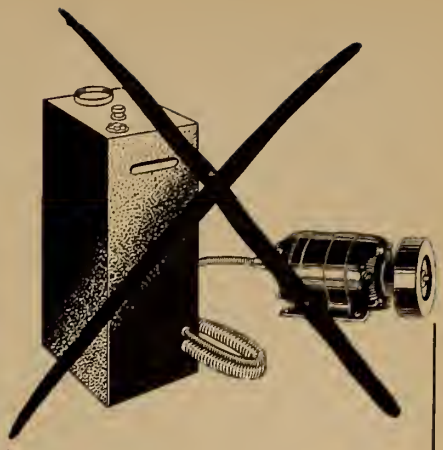
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restricted range of sound) has hitherto been the sole criterion of artist success.

Now the requirements broaden—but the supply of available talent does not. There should be a host of opportunities for a new generation of artists having "television personalities" and what these personalities require, only time and experience will disclose. The grist to the artists' mill may well be numbered in tens of thousands of candidates, the chaff in thousands, and the finely winnowed grain in hundreds. Yet only along this hard road must be found those who will successfully face the public on the television screen.

Inter-Industry Cordiality

Radio telephone broadcasting evolved, as an entertainment enterprise, in a curiously segregated fashion. Its relationships with other branches of the entertainment field have mostly been conspicuous by their absence. The phonograph, the disc record, the legitimate stage, the motion picture studio and theatre, musicians, authors, copyright owners, actors, instrumentalists and soloists have all been involved in radio development in one way or another; but he would be bold who would say that radio had made the most of its contacts with these fields or that the relationships which existed were, in the main, more than haphazard and occasionally unhappy.

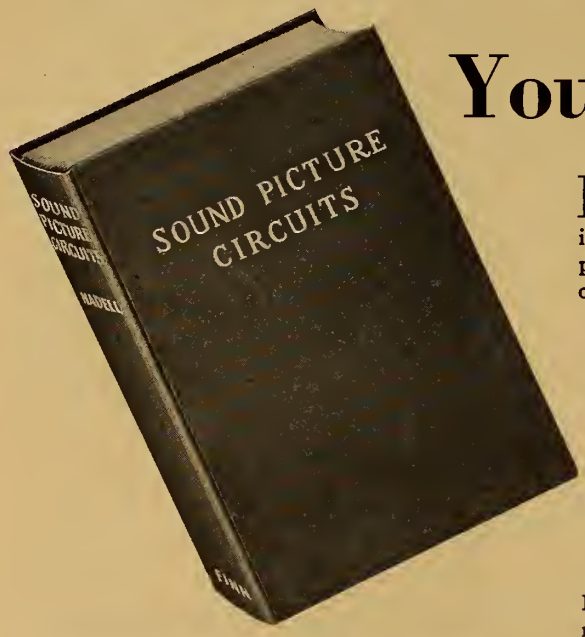
Television broadcasting faces similar but even more complicated and trying situations in this regard, and it would be well to remember that disregard or hostility, together with non-cooperation, rarely accomplish much. This thought applies, of course, not only to the radio facet of the situation but to all the other interests involved.

We have particularly in mind that the motion picture field (which, in our opinion, has little to fear from television broadcasting if it maintains a forward-looking outlook and is well guided), will have methods and output which can be somewhat adapted to the needs of a certain part of television procedure. Television can, in turn place at the disposal of the motion picture industry certain new methods and devices which should be useful. Certainly the relationship between these sister arts could and should be pleasant and mutually helpful in the best interests of each.

Eliminate Studio Audiences

At this point we urge that television broadcasting adopt the desirable practice of totally excluding the public from actual attendance at all rehearsals and broadcast events in the studio. It must be remembered that broadcasting aims to serve the millions of its radio audience in the home. It is not supposed to be a mode of amusing the advertising sponsor (who should have other and more practical aims) nor yet of entertaining the client's advertising agency. There is no question that program timing and the methods of production suffer when a compromise between the home audience and the studio audience is adopted.

It is also well known in the entertainment field that the illusion is spoiled when the audience "sees the wheels go



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round." What stage magician would show the audience how he performs his tricks? What great dramatic company on the stage would invite the audience to watch the scenery being shifted and to inspect the prompter at his work? Even the concert soloist keeps himself in desirable seclusion until the moment comes for him to step upon the stage. The motion picture industry has well realized this and has practically closed its studios to the public. This wise measure might well be adopted by television broadcasters who are in a similar position as regards entertainment possibilities.

Speaking frankly, we realize that building studios for home audiences only, conducting them in a practical, modest, and businesslike way, and retaining the illusion and consequent enjoyment of the home audience will involve some sacrifice of vanity on the part of client, agency, and broadcaster alike. But, as has been said, the entertainer is a vendor of illusion and a seller of glamor—or else he is nothing. Why then should he deliberately destroy part of his stock in trade? We have often heard persons who have just left a studio broadcast protest that they would not enjoy radio nearly so much now that they had seen the way in which program matters were actually handled or had a clearer picture of their favorite and previously idealized performer. We have listened to the annoyed protest of those who conduct broadcasting and who are compelled to go through useless motions and elaborate procedure for the hundreds in the studio in disregard of the millions in the home.

Let television broadcasting, at least, be democratic and devote its efficient, concentrated, and exclusive attention to the home audiences who purchase the receivers, who watch the performances and who give television broadcasting its very life.

So far as the commercial leaders and engineers of the radio manufacturing industry are concerned, their tasks in the new television field will be heavy indeed. Every mistake or omission of the past should be carefully remembered and as sedulously avoided in the future. If the industry elects to make a "breadboard model" of a television receiver one day and to turn out allegedly commercial manufactured product immediately thereafter, without adequate field tests and painstaking engineering study and improvement in the interim, the public will gain a most unfavorable impression of the quality, performance, and returns of the resulting product.

Quality Image Essential

It is hardly possible to devote too much care to the engineering design and test of the first large group of television receivers which the public purchases. An unfavorable first impression at this point will take years to eradicate. And in such engineering work, let us remember that although the skilled technician can handle a multiplicity of new, complicated, and delicate adjustments, the average tired man or woman at home neither can nor will go to the trouble of learning how to juggle a small-scale switchboard nor take the time and effort necessary to continue to use the electrical cross-word puzzle which is thus presented.

In other words, the engineers must be "home-minded" and leave the rarefied air of high but complicated technical achievement to come down to the lower and safer levels of simplicity and comfort in the use of television receivers.

Television comes into the world at a time when its nearest relatives have grown to maturity. For a relatively small sum, the public can see large, clear, and well-planned sound-motion pictures in impressive surroundings and under favorable physical and psychological conditions of presentation. In the home, not all the conditions are so favorable. Noise, stray light, interruptions both natural and man-made, inadequate seating arrangements for the audience and the like must be anticipated. Thus, we need the brightest, sharpest, and largest picture which can be economically and technically produced; and we must continue to improve the picture (and sound) in these regards as time goes on to hold public favor.

Further, it would be a wise investment to enlarge markedly the testing and supervisory force in factories devoted to television receiver manufacture. At best these new devices must be expected to

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develop unexpected troubles; and it is far better to discover these in the comparative privacy of the factory test than in the glaring spotlight of public indignation. Then, too, it will not be enough for the receiver to work as it leaves the factory. Every part should be carefully studied to make sure that it will stand up. Skilled television service men will not be too plentiful for the first months or years of television commercialization; and a dark television screen is as unattractive to the purchaser as a silent loud speaker.

We may presume that television circuits and models will naturally change fairly rapidly during the years of the introduction of television on a large scale to the public. This being the case, it is inadvisable further to complicate the commercial situation by exaggerating this tendency through the deliberate introduction of inconsequential or even imaginary "improvements," so-called, in reasonably satisfactory receiver models. A firm hand will be required on the commercial helm in this regard in every television-receiver factory. We must not be misinterpreted as regarding the early introduction of an actual and marked improvement as undesirable; we mean rather that we urge that television manufacture be not made the "happy hunting ground" of mere "gadgeteers."

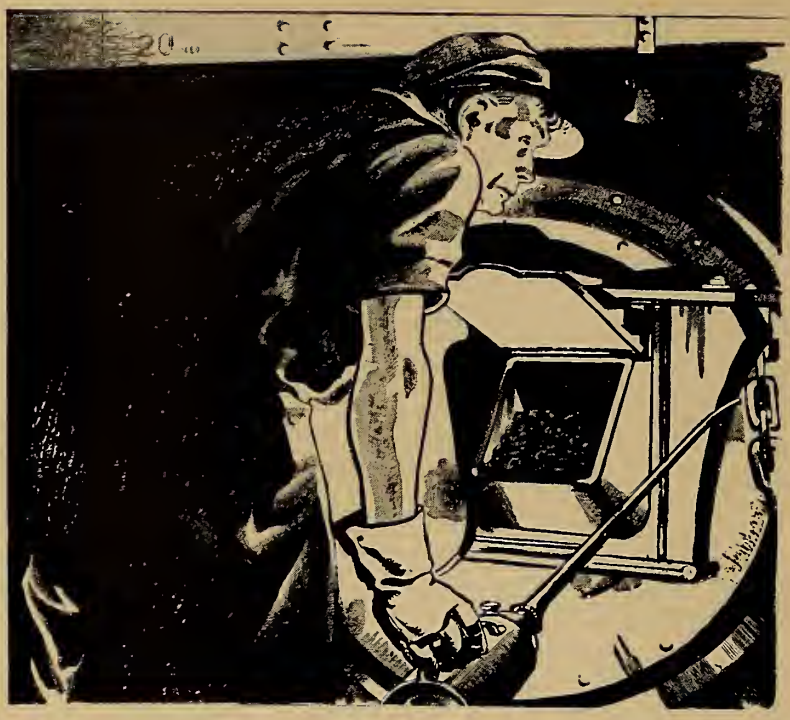
The service problem for television should not be left to grow at random as it largely did in the case of present-day broadcasting until recently. Training of service men by the manufacturers, radio schools, and associations of service men are notably in order. Since it will probably take a fair time to train a man to locate trouble in so elaborate a device as a television-telephone receiver and then to repair the fault, early consideration should be given to this need for training.

'Wildcat' Statements Deplored

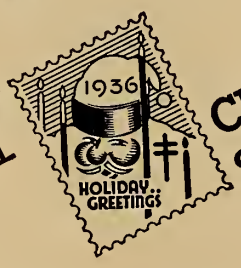
We have noticed without pleasure or approval some of the published material of a rather wild sort dealing with television. The implication of such sensational statements is that the fortunate owner of a cheap television receiver, seated in a comfortable armchair in his home, will touch a button and on the opposite wall will appear what looks like a huge motion picture in color, with sound, which reaches him by television.

A twist of the tuning dial and he will see at will a battlefield abroad, a performance equal to the finest feature films, a football game, or whatever other delightful performance his fancy can conjure up.

Without wishing in any way to present a gloomy picture of what will actually occur, it is fair to say that those who expect what has just been described will be sorely disappointed by the actual performance. A reasonable restraint in all statements made by individuals or by associations of manufacturers, of broadcasters, and of engineers will be useful in enabling performance to realize or, still better, to exceed expectations.



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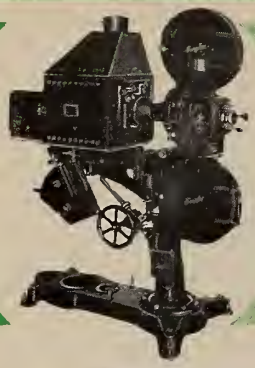
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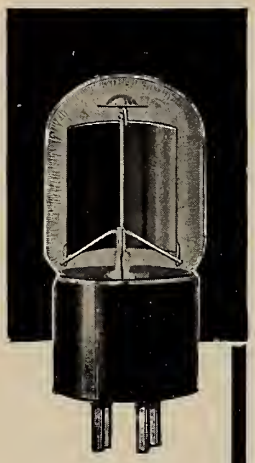
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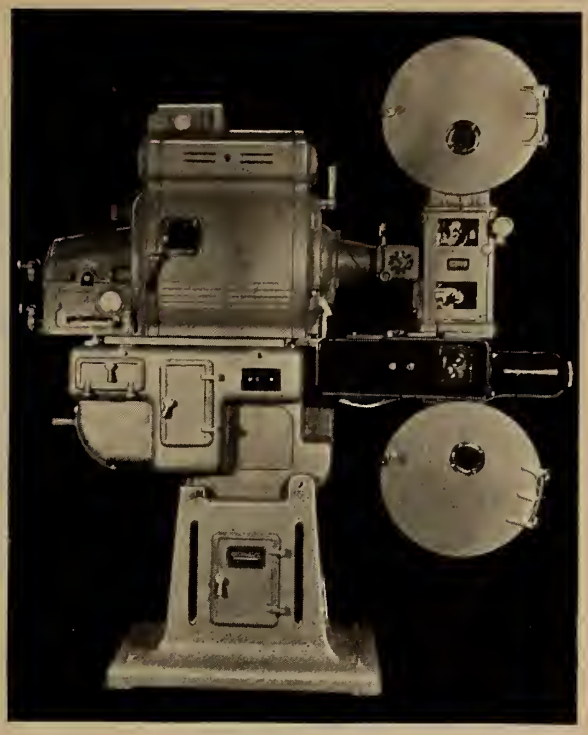
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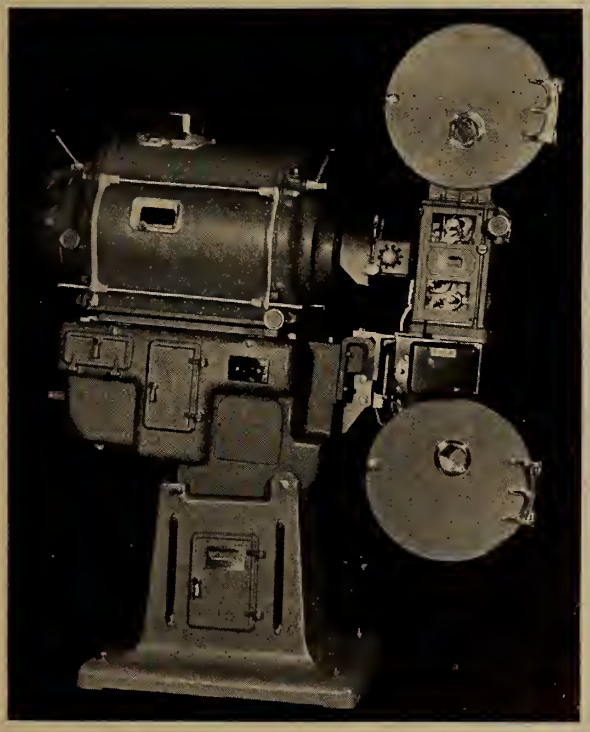
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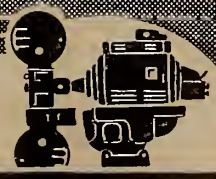
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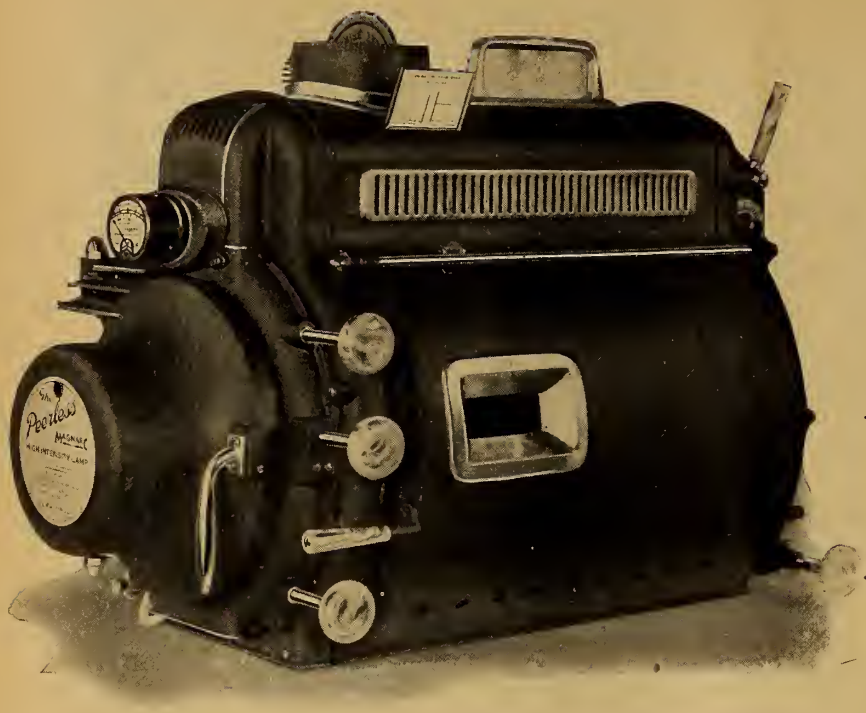
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Edited by James J. Finn

Volume 11 DECEMBER 1936 *Number 6*

Index and Monthly Chat..... 5

Structure and Maintenance of Sound Picture Speakers..... 7
JESSE A. COOK

I. A. Men Sponsor Projection Short Course at University of Florida 11

Film Footages, Room Fires, and Aperture Temperatures 12
FRANK DUDIAK

Notes on Cause of Feed-Back.. 15
J. P. ARNDT, JR.

Fire Prevention Methods in the Motion Picture Industry 16
H. ANDERSON

RCA Raditron Chart 18, 19

Suprex Arc Magnification Ratio 20
G. S. PATTERSON

The W. E. 86-Type Amplifier, Unit of the 'Mirrophonic' System 21
AARON NADELL

The W. E. 87-Type Amplifier.. 24

Letters to the Editor..... 25

The Editorial Page 27

News of the Month 28

Notes from the Supply Field .. 34

News Notes
Technical Hints
Miscellaneous Items

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MONTHLY CHAT

ONLY a month ago I. P. was chronicling the fact, in this space, that it had observed its fifth anniversary without benefit of a special issue, a testimonial banquet or a raft of congratulatory messages spread over several pages. This short, simple statement has resulted in messages from friends and strangers of a number and tone such as to occasion blushes that we really don't do more to earn such praise. The total of these messages would require not several pages but almost an entire issue. To one and all—we thank you.

I. P. IS running a temperature as a result of certain practices of sound equipment companies in selling their wares by "brand name" instead of by specific unit designation. Read all about it on the editorial page, and be guided accordingly.

MORE data on aperture temperature appears herein. After absorbing all this data we can be certain of only one thing—that the flash point of nitrate film is 320° F. Just what happens when the film starts sliding through the projector is a topic which induces a wide difference of opinion. One definite thing is that, irrespective of aperture temperature, nitrate film still should retain the respect of all who handle it.

An old friend, H. A. DeVry, in a letter to I. P. suggests the substitution of acetate stock, even though it would cost the industry a bit more for prints. Our own opinion being that the obvious advantages of nitrate film be retained, and that more pressure be exerted on keeping equipment up to snuff and in enforcing those few regulations which serve any useful purpose.

SOME there are who are contemptuous of projectionist attainment, charging that they are interested only in doing the least work for the most money. Their interest in new and novel products, designed to help do the job better, is nil—so it is said. Yet, within one month I. P. received more than 300 requests for information on a new unit which was allotted a single paragraph of 82 words!

OLD man 1937 promises to be a humdinger in projection circles: the onward rush of color, still more "modern" sound equipment, fundamental changes in projector and stand design, new tubes that will knock the field cold, vastly improved optics (not ready yet, so we can't tell you)—and, did we hear somebody mention television?

I. P. IS in a receptive mood toward pictures of interesting projection rooms, to which should be appended data as to size, equipment, the names of the crew and such other data as is considered pertinent.

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and a
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VOLUME XI NUMBER 6

DECEMBER 1936

STRUCTURE AND MAINTENANCE OF SOUND-PICTURE SPEAKERS

By *JESSE A. COOK*

THERE is probably no part of the theatre sound system that needs such careful attention as the horn and cone speaker units. These are commonly known as horn units, receivers, or loud speakers. Throughout this article the word "receiver" will be used to describe horn units, and "speakers" to describe cone type units.

Practically every theatre that has had sound pictures for three years or more has one one or more receivers that still are working and will continue to work for years if left in service but which should have had their diaphragms replaced by a competent receiver manufacturer months ago. This article will outline conditions that operate to damage receivers before the end of their normal useful life, and will cite simple steps in the care of typical receivers and economical methods of testing to disclose just which receivers are satisfactory for further use.

A receiver is a precision piece of apparatus and should be treated as such. Before putting a receiver into service, or before removing from service, all screws should be tightened. Also, every six months all screws should be checked for tightness.

Retaining Plate Pressure

In typical receivers [Fig. 1] the diaphragm retaining member, 3, is held tight to the case cover plate, 7, with screws. These screws determine the pressure on the fibre diaphragm insulating rings, 4. If these screws are too loose, the retaining plate which is not dowel-pinned will shift so as to bind the speech coil; if tightened down too much, the fibre rings and diaphragm will be damaged from the excessive pressure. The screws should all be tightened a little at a time until a torque of two foot-pounds is obtained on each screw.

As torque screw-drivers are made specially for factory use, a substitute will have to be used. A two foot-pound torque can be obtained by using the full strength of one hand on a screw-driver, having a smooth wooden handle 5/8" in diameter; or by using the full strength of just the end of the thumb and the forefinger on a screw-driver having a handle 1¼" in diameter. *Do not use the full strength of the whole hand on a large handle driver.*

Briefly, a diaphragm is like a drum head and bends back and forth thousands of times per second. After long

Speakers constitute one of the most important links in the theatre sound picture equipment chain, yet comparatively little attention has been paid to the servicing of these units. The author of this article is extremely well qualified for the task by reason of a wealth of experience, including five years with Western Electric Co., eight years with E. R. P. I., and, more recently, extensive field experience with the Co-Operative Sound Service Supply Co., of St. Louis.

I. P. hopes to be able to publish many more contributions by Mr. Cook, who will appreciate expressions of reader preference as a guide for future articles on sound reproducing equipment.—*Editor.*

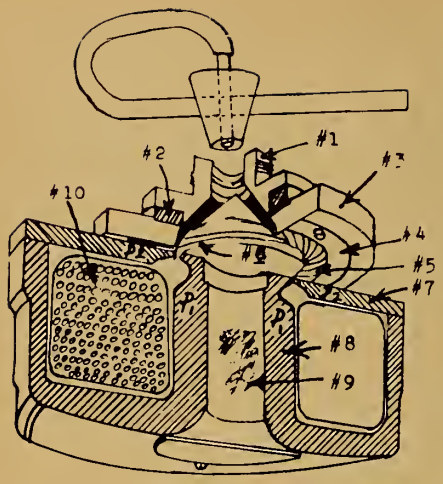


FIGURE 1

1. Horn receiver attaching piece. 2. Spacer ring with empire cloth above and below. 3. Diaphragm retaining member with spider-supported cone. 4. Diaphragm composition insulating and retaining rings. 5. Duraluminum diaphragm. 6. Speech coil. 7. Case cover plate constituting electromagnetic pole, P_2. 8. Main case, the centre of which constitutes electro-magnetic pole, P_1. 9. Wool, not to be disturbed. 10. Field winding.

continued use the diaphragm, instead of vibrating firmly, is so weakened that although it appears normal it crinkles like a piece of cellophane paper, and at the instant part of the diaphragm is traveling in one direction, another part is actually traveling in the opposite direction. A diaphragm found in this condition, checked by listening, is worn out for normal use and should be replaced.

Sometimes if a gun is fired in front of a horn the diaphragms will be split, the horn acting as a sound-vibration collector much the same as an ear trumpet. Even on football fields many feet from gun fire diaphragms have been damaged so that reproduction therefrom was seriously impaired. Diaphragms can be burst wide open by a single blow with a hammer on the horn that the units are working into. Care should be taken not to damage the receiver by sound vibrations of enormous magnitudes. Receiver diaphragms so damaged should be replaced.

A heavy rust will sometimes form on the pole pieces of receivers used in airdromes or receivers left in unheated closed houses. This rust is often so thick [over .003"], that the movement of the speech coil is not free. Sometimes these receivers can be cleaned, but usually the speech coil is damaged so that diaphragm and coil should be replaced.

A single iron filing in the receiver will always work its way into the highly magnetized gap between the pole pieces and the speech coil, thus damaging the coil. If the iron filing rubs the speech coil while receivers are being used, the coil and diaphragm usually need replacing, as part of the turns are frequently shorted. For this reason a receiver should only be dismantled on a clean table or bench.

If a receiver is removed from service and the mouth cap cannot be found, do not put a cork in the mouth. The upper compartment of the speaker is supposed to be airtight; if so the air pressure from the cork will spring the diaphragm so that it will thump back and forth in service like an oilcan bottom. The reproduction from a receiver so damaged sounds similar to the reproduction from a normal receiver driven by a Class "B" amplifier. A cloth over the mouth secured with a rubber band is sufficient to protect the receiver against dirt.

Simple Checking Aids

Eighteen inches of rubber tubing, four inch of copper tubing, some rubber tape or a single-hole rubber cork, and a lighted cigarette are the only materials necessary for a simple yet quite satisfactory method of checking the diaphragm and the upper chamber of the receiver. Remove the entire upper part of the receiver by removing the screws holding the case cover plate, 7 (Fig. 1) to the main casting, 8. [*Do not remove screws holding parts* 3 *and* 7 *together.*]

After these screws are removed the plate will probably still be held in position by dowel pins. The plate should be pried off evenly with screw-drivers, care being taken not to burr the surfaces or let loose iron burrs fall into the speech coil. After the top part is removed the rubber tube is corked into the hole in the receiver attaching piece, 1. The other end of the rubber tube should be operated with the mouth only, glass blower fashion, and not with a pump. A pump is noisy and too powerful. With a puff of smoke the receiver upper chamber can be tested for air leaks. This is important.

For example, if a hole 6 inches in diameter is cut in the very end of a 14-foot air column horn, no effect will be noticed. If a 2-inch hole is cut in this horn two feet from the receiver, the effect is quite noticeable, as is a hole ⅛" in diameter in the horn at a point close to the receiver. An air leak in the upper chamber of the receiver should be sealed if it can be done without obstructing the operation of the diaphragm. Now, by blowing and sucking on the rubber tube alternately in rapid succession, observe the clearance between the speech coil and the pole piece—which should be over .003" preferably .005" all the way around. Use a piece of thick bond paper as a gage, as anything stiffer may damage the delicate diaphragm or speech coil.

A diaphragm in a perfect receiver will be almost absolutely quiet in its operation. If it makes considerable noise when operated back and forth by successive air pressures and rarifications, the diaphragm has either been damaged or used longer than its normal life. An excessively noisy diaphragm should always be replaced.

Always remember that a receiver is a precision piece of apparatus which has been properly adjusted and damped before it leaves the factory. The damping wool in the pole piece cavity, if the receiver is of that type, should never be disturbed.

Replacement of Diaphragms

Diaphragms are on sale and installed by radio shops, but the writer recommends that receivers used in theatres or other public places be shipped to receiver manufacturers for replacements of diaphragms. These manufacturers do precision work and have elaborate test equipment. Many diaphragms installed in the field appear to be in good condition but fail to meet test requirements placed on receivers for strenuous theatre use.

Sound service men often have instruments to test the characteristics of the entire sound equipment up to the receivers, but very few have the instruments and equipment to thoroughly test receivers. At this writing probably more receivers will fail to meet reasonable test toleration limits than all other units or apparatus put together. As a rule, receivers that have had strenuous use for over three years should be removed from service and sent to a reliable concern for replacement of diaphragms. The time required to test such units is likely to be wasted, as such a small percentage are still good, and those that are barely acceptable have very little life left.

When putting new receivers into service, loose nails, bolts, nuts and supporting chains should be eliminated. Horns should be supported with steel cable instead of chains. Loose parts around the horns will vibrate to produce the same sound as defective receivers. Care should be taken also to properly pole receivers.

Polarity, Poling and Phasing

Wherever there are two coils in parallel so connected to a current sup-

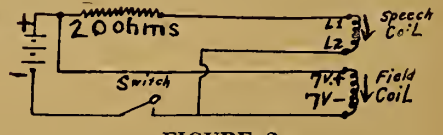


FIGURE 2

Diaphragm travel check: if the direction of windings is the same as shown by the figure, the currents are traveling in parallel and the diaphragm will be drawn back.

BRILLIANT

EASTMAN Super X won its first triumphs through remarkable adaptability to special situations. When it proved its superiority in *all* situations, it became an unparalleled find for the industry. Today it regularly runs the whole gamut of black-and-white cinematography with brilliant success. Eastman Kodak Company, Rochester, N. Y. (J. E. Brulatour, Inc., Distributors, Fort Lee, New York, Chicago, Hollywood.)

EASTMAN *SUPER X*

PANCHROMATIC NEGATIVE

Two famous names joined... giving Warner patrons RCA High Fidelity Sound!



WARNER BROS. COMPLETES PERFECT SOUND REPRODUCTION CHAIN . . . GETS NEW RCA CELLULAR SPEAKERS!

Besides installing RCA Photophone equipment in all its Chicago Theatres, Warner Brothers has also added the link that completes the chain of perfect sound reproduction. New RCA Cellular Speakers have been installed! These are the first speakers to evenly distribute all higher frequencies throughout a theatre. They have greater power capacity and provide undistorted reproduction of all notes—from lowest to highest. They require less room backstage.

RCA Photophone, the only motion picture sound apparatus offering the Rotary Stabilizer in every *unit, is chosen for all Warner Brothers Theatres in Chicago!*

THE sensational swing to RCA Photophone continues! And the newest member of this big parade is the pioneer of motion picture sound—Warner Brothers. The entire group of Warner Brothers houses in the large Chicago area is now included in the rapidly increasing number of motion picture exhibitors to select this superior equipment.

Offering progressive theatre owners 7 great proofs of its superiority, RCA Photophone is available at very moderate cost to houses of every size. It stands alone as a big profit builder. Let it build box office profits for YOU!

RCA presents Metropolitan Opera beginning Thurs. Dec. 24 and Sat. afternoons thereafter. Also "The Magic Key of RCA" Sundays 2 to 3 P. M., E. S. T. Both via NBC Blue Network.

RCA Photophone

RCA TRANS-LUX RCA SONOTONE

RCA MANUFACTURING CO., INC., CAMDEN, N. J. • A Service of the Radio Corporation of America

ply that the currents in both are in the same direction, the coils will exert a force to move in such a direction as to increase the magnetism, or, in other words, toward the central neutral point of the magnet. If either coil is reversed or the current reversed in one coil, the reversed action will take place.

In a receiver the field coil is fixed and controls the magnetism entirely; while the speech coil can move by bending the diaphragm in either direction, depending upon the direction of the current supplied to it. We are not concerned as to what direction the coils are wound, but the relative direction of the windings to each other and the resultant direction of travel of the diaphragms are most important.

All like speakers operating in the same direction close together should be poled alike. If the diaphragms are visible,

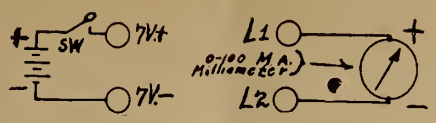


FIGURE 3

Milliameter deflection check: when the windings are in parallel (see Fig. 2) the meter will show positive deflection on make of battery circuit, and negative deflection on break of battery circuit.

either the diaphragm travel check or millimeter check can be used [see Figs. 2 and 3]. If the diaphragms are not visible, only the millimeter check can be used [see Fig. 3]. Understand that receivers need not be poled in the same direction as shown in Fig. 3. The important thing is that all currents in the coils *bear the same relation to each other* in like speakers, as mentioned previously. When this is accomplished the diaphragm travel will be correct.

For example, the "Wide Range" [W. E.] middle frequency receivers and the "Mirrophonic" bass speakers are poled as shown in Fig. 2; but the "Wide Range" bass speakers and "Mirrophonic" high-frequency receivers are the opposite to that shown by the figure. These differences in commercial units are of very little importance, but it is important to pole all like units as described above. As poling of receivers and speakers has been covered in other articles, it is only briefly reviewed here.

Phasing is highly mathematical and too complicated to be covered in this article. This is always done by the installation engineer at time of installation and corrected from time to time as necessitated by other changes about the auditorium in which the phased groups work.

I. A. Men Sponsor Projection Short Course at Univ. of Florida

MEMBERS of the various I. A. Locals of Florida attended a short course in Projection Practice and Sound Theory at the University of Florida School of Adult Education at Camp Roosevelt, the week of Dec. 14, with more than forty registered projectionists in attendance. The School is the new branch of the University which is conducting a broad program in training of adults this year.

This short course for projectionists is the first of a series for organized labor groups of Florida, which the School expects to conduct this year.

Prominent representatives from the leading sound motion picture and projection apparatus manufacturers were in attendance, and conducted classes in the proper operation and maintenance of their products. Equipment displayed and demonstrated was of the latest design and incorporated many features as yet not on the market. The manufacturers spared no expense in cooperating with University officials in making the venture a success.

It is believed this is the first time that a study course of this type has been offered I. A. projectionists. R. J. Gavin of Local 511, Jacksonville, and George E. Raywood of Local 316, Miami, assisted the University with arrangements.

The following manufacturers and representatives were in attendance:

Representative Group Attends

Messrs. C. J. Swinney, H. M. Leighley and J. C. Faulstich, of RCA Photophone; C. C. Kauffman, Erpi; J. E. (Magnarc) McAuley; Harry (Mogul) Strong; Karl (Enarc) Brenkert; C. C. Dash of Hertner Elec.; Les (Motiograph) Abbott; R. E. Ward, of Weston Instrument; Paul (National Carbon) King; J. K. (Forest Rectifier) Elderkin, Forest Elec.; and C. D. Porter, of Wilkin Supply Co., Atlanta.

Projectionists who attended were: from BRADENTON: Joe Saunders; DAYTONA BEACH: C. L. Forsythe and M. E. Forsythe; FORT LAUDERDALE: L. A. Cash; JACKSONVILLE: Max Friedman, R. J. Gavin, Roy Harding, and O. G. Taylor; LAKELAND: A. D. Bowden; MIAMI: C. M. Boyd, O. T. Brackin, J. A. Campbell, R. B. Day, T. E. Holcomb, R. E. Lewis, T. R. Ragland, G. E. Raywood, A. Sands, J. Shafer, H. L. Bates, and W. R. Thagard.

Also present were: ORLANDO: J. B. Prine; PALM BEACH: L. A. Gamage; ST. PETERSBURG: J. M. Davis; SARASOTA: A. G. Hurton and J. A. Scobie; TAMPA: J. B. Fette, J. F. Fette, H. Gordon, and H. Wegman; W. PALM BEACH: J. W. Cummings.



One of the sessions at Florida U. projection course. Note varied late-type equipment.

FILM FOOTAGES, ROOM FIRES AND APERTURE TEMPERATURES

By *FRANK DUDIAK*
PROJECTIONIST, FAIRMONT (W. VA.) THEATRE

SO dangerous are the gases evolved during a film fire that it is almost impossible to advise projectionists as to procedure under such circumstances. Most fellows attempt to do two things: (1) safeguard the audience and conceal the fact of a film fire, and (2) save the film and the room equipment. The advent of double reels, accompanied by several projectionist deaths, makes one wonder which of us is next.

Our slant is that the boys should always keep in mind the fact that film stock and equipment are much cheaper than human flesh. We have never heard of a projectionist shirking his duty to an audience: we all seem to react to this proposition automatically and in the right way. But film stock and equipment are replaceable; human flesh is not.

* * *

Our recent statement as to the dangerous potentialities of a Suprex arc when operated without rear-shutter equipment evidently intrigued the editor of I. P., who in a footnote asked that we elaborate on the statement. We meant to include not only Suprex but all other lamps with a high-total light flux.

We found that after 10 minutes of operation, even when using a rear shutter and with the projector running, the aperture temperature was 250° F. Proceeding further, we ascertained the temperature of the light flux at the aperture on the film side of the front plate. With the projector idle, and the rear shutter and the fire shutter open (this set-up being equivalent to a projector with a front shutter) the temperature after a period of 3½ minutes was 552° C., or 1025° F.

Since nitrate film ignites at 320° F., one can imagine the result should the film accidentally touch the edge of the aperture, with a temperature of at least 500° F. A recent fire in a Penna. theatre started when a piece of film touched the projector cooling plate. More than 20 reels of film were destroyed, along with the entire theatre front. The projectionists, happily, escaped uninjured.

JUST what is the actual temperature of the light falling upon the film at the aperture? The accompanying compilation was made not only to ascertain the Suprex arc temperatures but to compare these figures with those of other arcs, including the Hi-Low.

The tests were made under practical projection room operating conditions, utilizing a mercury centigrade-scale thermometer with an upper limit of 550°. During each trial the thermometer bulb was placed on the film side of the front plate on a Simplex mechanism; the film gate was released in order to hold the thermometer in the film plane, as would be the case were the machine threaded.

All readings are given in the Centigrade scale. To convert any of these readings to Fabrenheit, simply multiply by 1.8 and then add 32.

The data in Table A were obtained with a rear-shutter equipped projector *running* at 90 feet per minute. Arc current was 32.5 volts and 60 amperes on a Suprex lamp. The carbon trim was a 6.5 mm. x 9″ negative, and the positive was 8 mm. x 12″.

The readings given in Table B were made with the same equipment and under identical conditions applying to Table A, except that the projector was *idle*. The revolving shutter and the fire shutter were opened so that the beam of light would not be obstructed in any way. This set-up was equivalent to a projector without rear-shutter equipment. Because the limit of the scale was reached in 3½ minutes, it was necessary to terminate the test at that point.

Table C presents the readings obtained with a Simplex mechanism without rear-shutter equipment. The light source was a Peerless Hi-Low reflector lamp operating at 42.5 volts and 57 amperes. The carbon trim was a 5/16 x 9″ negative, and a 9 mm. x 20″ positive.

Average Light Temperature

Since our purpose has already been shown by reference to the tables, we may conclude by pointing out that the last reading in Table A is an average temperature of the light during each complete revolution of the shutter. Thus, when the shutter is in the open position, the temperature is in the neighborhood of 323° F., or 552° C.; when the shutter is closed the true temperature is zero degrees.

Because of the physical limitation of the thermometer used it could not respond to these instant changes (the shutter changes its position every 0.0625 second), therefore the final reading is an average of the total light over a period of time. The final readings in Tables B and C (assuming no errors) are true temperatures of the light on the film plane. All preceding readings therein reflect the fact that since mercury expands very slowly a period of time is required before the temperature

(*Continued on second page following*)

TABLE A

Elapsed Time in Minutes	Temperature in Degrees C.
1	179
2	228
3	259
4	272
5	295
6	297
7	299
8	306
9	313
10	316
11	323
12	322
13	323
14	323
15	323

TABLE B

Elapsed Time in Minutes	Temperature in Degrees C.
½	270
1	420
1½	514
2	528
2½	542
3	548
3½	552

TABLE C

Elapsed Time in Minutes	Temperature in Degrees C.
1	235
2	286
3	309
4	317
5	322
6	333
7	337
8	337
9	337

Increased

Box office dollars
tell the story of
millions of ears
thrilled by

THE NEW
Western Electric
MIRROPHONIC
SOUND SYSTEM

HIGH INTENSITY PROJECTION



THEATRE patrons desire enough supplementary lighting for comfortable vision from the moment of entrance. They are annoyed when a dark theatre compels them to stumble and grope blindly for their seats.

High Intensity Projection permits ample side lighting for a comfortable level of general illumination. It improves the quality of black and white projection and brings out the full beauty and realism of color productions.



INSTALL HIGH INTENSITY LAMPS IN YOUR THEATRE

They Insure Sustained Patronage

There is a High Intensity Lamp, A.C. or D.C., for every theatre, large or small.

There is a National Projector Carbon for every Projection Lamp.

NATIONAL HIGH INTENSITY PROJECTOR CARBON COMBINATIONS

D.C., High Intensity Lamps—Condenser Type

Amperes	Positive Carbon	Negative Carbon
120-130	13.6 mm. x 22″ National High Intensity White Flame	$\frac{3}{8}$″ or $\frac{7}{16}$″ x 9″ National Orotip Cored Projector
140-160	16 mm. x 20″ National High Intensity White Flame	$\frac{7}{16}$″ x 9″ Extra Heavy Coated, National Orotip Cored Projector

D.C., "High-Low," Reflector Arc Lamps

60-85	9 mm. x 20″ National "High-Low" White Flame	$\frac{5}{16}$″ x 6″ or 9″ National Orotip Cored Projector

D.C., High Intensity Lamps with Non-rotating Positives

42-50	7 mm. x 12″ SUPREX Cored	6 mm. x 9″ SUPREX Cored
56-65	8 mm. x 12″ SUPREX Cored	6.5 or 7 mm. x 9″ SUPREX Cored

A.C., High Intensity Lamps

60-65	7 mm. x 12″ National Copper Coated A.C. High Intensity
75-80	8 mm. x 12″ National Copper Coated A.C. High Intensity



PROJECTOR CARBONS



NATIONAL CARBON COMPANY, INC.

Carbon Sales Division, Cleveland, Ohio

Unit of Union Carbide UCC and Carbon Corporation

Branch Sales Offices

New York ❖ Pittsburgh ❖ Chicago ❖ San Francisco

of the mercury and that of the light source reach a state of equilibrium.
[Note: See editorial anent foregoing tests.]

* * *

Much has been said and little done relative to providing a reliable method for gauging the correct time of a film show, including shorts and features. Both the exchanges and publications (excuse us, J.J.F.) have neglected their duty in this respect. The conflict here is one of showmanship *vs.* expense. Managers want a full show, of course, but are unwilling to pay for overtime when required. None of us can subscribe wholeheartedly to the policy of cutting a reel or more out of a feature—which practice, by the way, is widespread.

Correct footage may be obtained from the laboratory markings on the outer film margin. On some double reels the footage numerals run consecutively throughout the film length, especially on new uncut prints. This is not much comfort, however, to those in subsequent-run theatres.

Footage-measuring devices are available, of course; but what manager will willingly supply such an aid? Even some of these devices are unsuitable because of inherent error, which when multiplied many times may average as much as 25 minutes off-schedule on a day's run.

The suggestion has been made that, since exchanges are presumed (?) to inspect all reels after each showing, they should be able to supply the subsequent-run theatre with the exact footage. We assume that counters are used on exchange inspection machines. Well, why not?

NOTES ON THE CAUSE OF FEED-BACK

By *J. P. ARNDT, JR.*
BRUSH DEVELOPMENT COMPANY

THE unhappy fact that peaks invite feed-back is well known to most sound engineers, and the howl from "feed" often assumes nightmare proportions. The explanation of its cause and the suggested use of "quality" equipment to reduce it form an interesting subject for discussion.

As is generally known, feed-back or oscillation in a p. a. system takes place when the output of the microphone, due to a sound reaching it from the loud speaker, is amplified to a level greater than that required to cause the original sound in the loud speaker. The result is a louder sound from the speaker, producing still more microphone output and therefore still more amplified output supplied to the speaker, *etc.*

The response characteristics of the microphone, amplifier, and loud speaker, together with the acoustics of the location, all enter into the feed-back problem. For the purpose of this article let us assume that in our p. a. system the amplifier has perfectly "flat" response over the acoustic range, and also assume that sounds of all frequencies within the range emanating from the speaker are transmitted to the microphone with equal efficiency.

Now, if we advance the gain control of the amplifier, we finally reach a point where the amplifier gain exceeds the sum of the electrical, electro-acoustic and acoustic losses. When this point is reached the system oscillates, and the frequency of oscillation is the frequency at which the difference between total gain and total loss is maximum. If our microphone and speaker also are perfectly "flat," then the difference between gain and loss is the same at all frequencies and feed-back may occur at any frequency.

If we reduce the gain until it is slightly less than the total loss in the system, feed-back stops. Now, if we talk into the microphone, the speaker will reproduce our voice at a certain level depending on how loud we speak and at what distance we stand from the microphone.

Now, consider another microphone having the same response and output level as the microphone in our perfect p. a. system, except for a 15 d.b. peak at 2,500 cycles. Due to this 15 d.b. peak the electro-acoustic loss of the microphone at 2,500 cycles is 15 d.b. less than at other frequencies. If we substitute this microphone for our flat microphone, we will have, except at 2,500 cycles, the same condition as existed originally, i.e., the loss slightly exceeding the gain, thus preventing feed-back.

Quality Is Determining Factor

At 2,500 cycles, however, the loss is reduced by 15 decibels, so the gain at 2,500 cycles exceeds the loss by nearly 15 decibels. This is all that is necessary for feed-back.

To stop feed-back in this instance we must reduce the gain by 15 d.b. Now, if we talk into the microphone as before, we find that, except for the 2,500-cycle components in our voice, the output of the speaker is 15 d.b. lower than in the first case. In other words, replacing a "flat" microphone in the perfect p. a. system by a microphone having a peak reduces the allowable output of the speaker by the amount of the peak. The same, of course, holds true for peaks introduced by any other apparatus or by the acoustics of the location.

Thus it can be seen that, aside from the advantages of much more faithful reproduction, the use of "flat" microphone and speakers permits more loud speaker volume without feed-back.

"As the use of the 2,000-foot reel increases, it doesn't take a great stretch of the imagination to visualize what may happen if reels continue to grow in size. Some day we may be able to put the entire show on one reel. What with automatic carbon feeds and no changeovers, the operator may be able to catch up on his sleep at home. We wonder if he'll forget to come down Saturday night to sign the payroll!"



The above cartoon and caption is reprinted from "Showmen's Trade Review." It serves admirably to prove: (1) how exhibitor papers are "boosting" projection and how much fairplay the craft may expect therefrom; (2) how senseless were the arguments advanced that exhibitors would never tie-in the introduction of the long reel with requests for decreased manpower. Why, the sweet darlings wouldn't even think of such a thing! (About 7,000 of them are thinking hard about it now, thanks to this cartoon); and (3) how wise were those units of the organized craft (not more than 3) who sensed the "angle" behind the double reel and fought it, while their complacent sister units were wallowing in the favor of the distributors and breaking their necks to put over the long reel. Enuf!

FIRE PREVENTION METHODS IN THE MOTION PICTURE INDUSTRY

By *H. ANDERSON*
INSURANCE DEPARTMENT, PARAMOUNT PICTURES, INC.

THE subject of fire prevention in the motion picture industry is an extremely broad one. The motion picture industry embraces almost every known science, art, and profession, and the foremost developments in almost every branch of applied science. It likewise involves practically every known fire hazard and fire risk, and its fire-fighting and fire-prevention problems are exceedingly complex.

A serious studio fire may curtail production for weeks or months. A minor fire in complicated laboratory apparatus may put the laboratory out of service for a long period of time. A fire seriously damaging the sound recording equipment might delay studio operations for months. A large motion picture corporation might through a serious studio fire find its entire financial structure impaired. The jobs of thousands of persons might be imperiled by such a fire. A fire in an exchange means not only a loss to the distributor but may involve serious loss to exhibitors, due to inability to supply film on schedule. A fire in a theatre may involve loss of life. The amounts of film handled by the industry are enormous. Statistics could best be presented in astronomical units such as light years.

The problem of fire prevention in our industry is increased because our basic product, film, is readily combustible. We are constantly confronted with this fact, and film must be surrounded by every reasonable safeguard, from the manufacturer's plant to its final disposition as scrap. We are further confronted with the fact that film is highly susceptible to damage by water and smoke.

The industry does not stop at the doors of its exchanges in active fire prevention. For example. every exchange is followed up by the M. P. P. D. A. (Hays Organization) as to its method of disposing of scrap film. The industry has tightened up on non-professional use of film, which at one time occurred freely in churches, schools, and institutions. The Conservation Department recently investigated 4,000 schools, churches, orphanages, and penal and other institutions to determine the safety of their

The motion picture industry's chief stock-in-trade are rolls of film of varying length, which are highly inflammable. Because this film has no real value until it is properly merchandised through projection, unusual precautions to safeguard it are taken—from studio set to theatre, and particularly in the latter. The means employed to prevent film fires all along the route are set forth in the accompanying paper, originally presented before the SMPE, in addition to much valuable data relative to fire-fighting aids—a compilation by an acknowledged expert on the subject.—*Editor.*

motion picture projection arrangements. About 3,000 of these institutions were approved for the continued use of film, and this work alone brought about the installation of 360 standard fire-resistive booths in institutions not properly equipped, all of which has greatly reduced the hazard to life and to property.

Fire Extinguishing Equipment

One of the constantly recurring problems is to determine the type of fire extinguishing equipment best suited for any particular purpose. There is a great deal of misunderstanding and even misrepresentation with respect to various fire extinguishing devices, and the engineer should have some knowledge of this subject. Space will not permit going into the theory of fire and fire extinguishing in detail; but in brief, fire is oxidation with liberation of heat, and fires are extinguished either by excluding oxygen or by cooling the substance to a temperature below its burning point; or there may be a combination of the two methods.

We might ignite a piece of paper in a glass jar and then cover the top of the jar, excluding the air. The paper will stop burning as soon as the oxygen contained in the air in the glass has been exhausted. If we pour water upon burning paper, the burning ceases, because we thus cool the paper to a temperature below its ignition point. However, it is not as simple as all that, for there are many modifications.

For example, nitrocelluose film contains in itself the elements of combustion, and we can not extinguish burning film by excluding oxygen. Therefore, we should not look to an extinguisher that depends upon a smothering effect for extinguishing film fires. The only effective agent would be a liquid having sufficient cooling capacity to reduce the temperature of the burning film to below its ignition point. Water seems to be the one best all-around agent for that purpose.

In order to obtain a clearer picture of accepted fire-fighting methods it is necessary to have a knowledge of the principal types of extinguishers in general use. They are as follows:

Soda-Acid.—This is the familiar 2½-gallon brass tank equipped with a hose. It contains a solution of bicarbonate of soda in water and a container filled with sulphuric acid. When the extinguisher is inverted, the two mix forming carbon dioxide gas, which produces a pressure and forces the liquid through the hose. It has the same extinguishing effect as an equivalent amount of water, and is recommended for general use where water would be effective. The extinguisher is made in capacities up to 80 gallons. [Obviously for studio use.—Ed.]

Foam.—This type depends for its effectiveness upon applying to the burning material a blanket of foam containing bubbles of carbon dioxide, and is effective because of the smothering effect of the foam. It is effective particularly in gasoline and oil fires, but should not be used on electrical apparatus. Portable extinguishers are similar in appearance to the soda-acid type. Fixed equipment is often provided for gasoline and oil storage tanks.

Carbon Dioxide.—This type consists of a cylinder charged with carbon dioxide gas, and may be either portable

(*Continued on page* 31)







OPERATORS OF RCA PHOTOPHONE

. . . the superior sound equipment

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—AND HERE'S WHY!

RCA Radiotrons are designed by the world's foremost sound engineers. Manufactured to exacting standards by skilled workers on the most modern and scientific equipment.

RCA Radiotrons' sturdy construction and fine performance greatly lessen equipment trouble and costly servicing.

RCA Radiotrons are used in the majority of sound equipment installations—proof that they are the outstanding preference of most projectionists.

RCA Radiotrons are always easily available. All RCA dealers have them—and there are RCA dealers in every community.

RCA Radiotrons come to you in tamper-proof sealed cartons. You *know* they are *new* tubes—and carton construction is such that tubes can be tested before seal is broken.

RCA Radiotrons are guaranteed—a product of a reliable organization—RCA!

RCA presents the Metropolitan Opera beginning Thursday, Dec. 24 and Saturday afternoons thereafter. And "The Magic Key" every Sunday, 2 to 3 P.M., E.S.T. Both on NBC Blue Network.

RCA

Radiotrons

RCA MANUFACTURING COMPANY, INC., CAMDEN, NEW JERSEY

A SERVICE OF THE RADIO CORPORATION OF AMERICA

CHART OF RADIOTRONS F

TYPE	NAME	BASE	SOCKET CONNEC-TIONS	DIMENSIONS MAXIMUM OVERALL LENGTH X DIAMETER	CATHODE TYPE	RATING FILAMENT OR HEATER VOLTS	RATING FILAMENT OR HEATER AMPERES	RATING PLATE MAX. VOLTS	RATING SCREEN MAX. VOLTS	USE Values give op conditi charact for ind typical
2A3	Power Amplif. Triode	Medium 4-Pin	Fig. 1	5-3/8" X 2-1/16"	Filament	2.5	2.5	250 300	- -	Class A Push-P Amplif
5Z3	Full-wave Rectifier	Medium 4-Pin	Fig. 2	5-3/8" X 2-1/16"	Filament	5.0	3.0	-	-	
6C6	Amplifier	Small 6-Pin	Fig. 7	4-15/16"X1-9/16"	Heater	6.3	0.3	250	100	Screen Amplif
10	Power Amplif. Triode	Medium 4-Pin	Fig. 1	5-5/8" X 2-3/16"	Filament	7.5	1.25	425	-	Class A
24-A	Amplifier Tetrode	Medium 5-Pin	Fig. 6	5-1/32"X 1-13/16"	Heater	2.5	1.75	275	90	Screen Amplif
27	Amplifier	Medium 5-Pin	Fig. 5	4-1/4" X 1-9/16"	Heater	2.5	1.75	275	-	Class A
42	Power Amplif. Pentode	Medium 6-Pin	Fig. 9	4-11/16"X1-13/16"	Heater	6.3	0.7	250	250	Class A
45	Power Amplif. Triode	Medium 4-Pin	Fig. 1	4-11/16"X1-13/16"	Filament	2.5	1.5	275	-	Class A
47	Power Amplif. Pentode	Medium 5-Pin	Fig. 4	5-3/8" X 2-1/16"	Filament	2.5	1.75	250	250	Class A
50	Power Amplif. Triode	Medium 4-Pin	Fig. 1	6-1/4" X 2-11/16"	Filament	7.5	1.25	450	-	Class A
56	Amplifier	Small 5-Pin	Fig. 5	4-1/4" X 1-9/16"	Heater	2.5	1.0	250	-	Class A
57	Detector	Small 6-Pin	Fig. 7	4-15/16"X 1-9/16"	Heater	2.5	1.0	250	100	Screen Amplif
59	Triple-grid Power Amplif.	Medium 7-Pin	Fig. 10	5-3/8" X 2-1/16"	Heater	2.5	2.0	250 250 400	- 250 -	As Trio Class A As Pent Class A As Trio Class B
75	Duplex-diode High-Mu Triode	Small 6-Pin	Fig. 8	4-17/32"X 1-9/16"	Heater	6.3	0.3	250	-	Triode Class A
76	Amplifier	Small 5-Pin	Fig. 5	4-1/4" X 1-9/16"	Heater	6.3	0.3	250	-	Class A
80	Full-wave Rectifier	Medium 4-Pin	Fig. 2	4-11/16"X1-13/16"	Filament	5.0	2.0	-	-	A-C Vol D-C Out
81	Half-wave Rectifier	Medium 4-Pin	Fig. 3	6-1/4" X 2-7/16"	Filament	7.5	1.25	-	-	
83	Full-wave Rectifier	Medium 4-Pin	Fig. 2	5-3/8" X 2-1/16"	Filament	5.0	3.0	-	-	Maximum Maximum
112-A	Amplifier Triode	Medium 4-Pin	Fig. 1	4-11/16"X1-13/16"	D-C Filament	5.0	0.25	180	-	Class A
845	Amplifier Triode	Jumbo 4-Pin	-	7-7/8" X 2-15/16"	A-C Filament	10	3.25	1250	-	Class A
866	Half-wave Rectifier	Large 4-Pin	Fig. 11	6-5/8" X 2-7/16"	Filament	2.5	5.0	-	-	
868	Phototube	Small 4-Pin	-	-	See Manufacturer's Specifications					
920	Phototube	Small 4-Pin	-	-	See Manufacturer's Specifications					

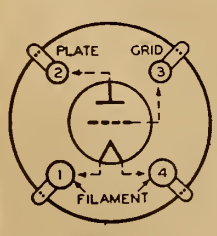


FIG.1

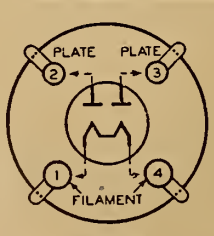


FIG.2

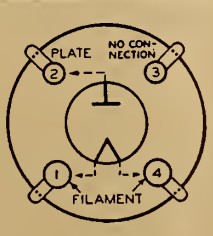


FIG.3

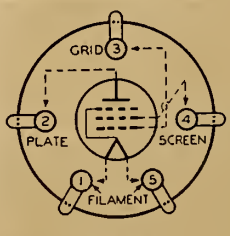


FIG.4

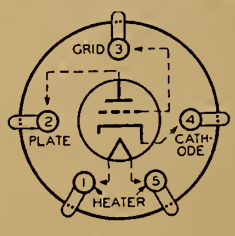


FIG.5

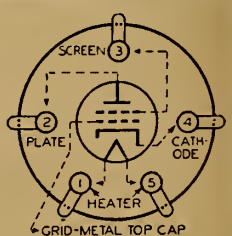
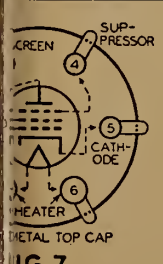


FIG.6

INTERNATIONAL

	PLATE SUPPLY VOLTS	GRID VOLTS	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESISTANCE OHMS	MUTUAL CONDUCTANCE MICROMHOS	VOLTAGE AMPLIFICATION FACTOR	LOAD FOR STATED POWER OUTPUT OHMS	POWER OUTPUT WATTS	TYPE
f.	250	-45	-	-	60.0	800	5250	4.2	2500	3.5	
	300	-62	Self-bias		40.0	Power Output is for 2			5000	10.0	2A3
	300	-62	Fixed-bias		40.0	tubes at stated load, Plate-to-plate			3000	15.0	
Maximum A-C Voltage per Plate.....500 Volts, RMS Maximum D-C Output Current.....250 Milliamperes											5Z3
						exceeds		exceeds			6C6
	250	-3.0	100	0.5	2.0	1.5 meg.	1225	1500	-	-	
f.	350	-31.0			16.0	5150	1550	8.0	11000	0.9	10
	425	-39.0	-	-	18.0	5000	1600	8.0	10200	1.6	
	180	- 3.0	90	1.7	4.0	400000	1000	400			24-A
	250	-3.0	90	1.7	4.0	600000	1050	630	-	-	
f.	135	- 9.0			4.5	9000	1000	9.0			27
	250	-21.0	-	-	5.2	9250	975	9.0	-	-	
f.	250	-16.5	250	6.5	34.0	100000	2200	220	7000	3.00	42
	180	-31.5	180		31.0	1650	2125	3.5	2700	0.82	
f.	250	-50.0	250	-	34.0	1610	2175	3.5	3900	1.60	45
	275	-56.0	275		36.0	1700	2050	3.5	4600	2.00	
f.	250	-16.5	250	6.0	31.0	60000	2500	150	7000	2.7	47
	300	-54.0			35.0	2000	1900	3.8	4600	1.6	
f.	400	-70.0	-	-	55.0	1800	2100	3.8	3670	3.4	50
	450	-84.0			55.0	1800	2100	3.8	4350	4.6	
f.	250	-13.5	-	-	5.0	9500	1450	13.8	-	-	56
						exceeds		exceeds			
	250	- 3.0	100	0.5	2.0	1.5 meg.	1225	1500	-	-	57
	250	-28.0	-	-	26.0	2300	2600	6.0	5000	1.25	
f.											
	250	-18.0	250	9.0	35.0	40000	2500	100	6000	3.00	59
f.											
	300	0			Power output values are for 2				4600	15.0	
f.	400	0	-	-	tubes at indicated plate-to-plate load.				6000	20.0	
As f.	250	-1.35	-	-	0.4	-	-	Gain per stage = 50-60			75
f.	250	-13.5	-	-	5.0	9500	1450	13.8	-	-	76
per Plate (Volts RMS) 350 400 550 The 550 volt rating applies to filter urrent (Max. MA.) 125 110 135 circuits having an input choke of at least 20 henries.											80
Maximum A-C Plate Voltage.....700 Volts, RMS Maximum D-C Output Current..... 85 Milliamperes											81
Volt. per Plate...500 Volts, RMS Maximum Peak Inverse Voltate...1400 Volts Output Current....250 MilliamperesMaximum Peak Plate Current..... 800 Milliamp.											83
	90	- 4.5			5.0	5400	1575	8.5			112-A
f.	180	-13.5	-	-	7.7	4700	1800	8.5	-	-	
f.	1000	-147	-	-	75	1800	3000	5.0	7500	23	845
Maximum Peak Inverse Voltage...7500 volts Maximum D-C Output Current.....0.25 amperes											866
											868
											920



IG.7

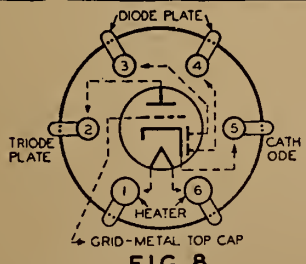


FIG.8

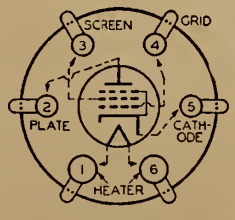


FIG.9

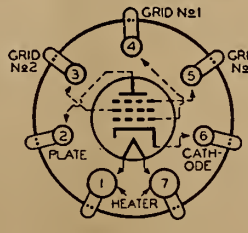


FIG.10

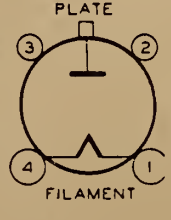


FIG.11

SOCKET connections shown are bottom views of the socket. Pin numbers on socket diagrams are shown according to the system standardized by the Radio Manufacturers Association.

Maximum peak inverse voltage characteristic of a rectifier tube is the highest peak voltage that a rectifier tube can safely stand in the direction opposite to that in which it is designed to pass current.

In single-phase, full-wave circuits with no condenser across the output, this voltage is approximately 1.4 times the RMS value of the plate voltage applied to the tube.

In single-phase, half-wave circuits, with condenser input to the filter, the peak inverse voltage may be as high as 2.8 times the RMS value of the applied plate voltage.

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CHART OF RADIOTRONS FOR THEATER USE

TYPE	NAME	BASE	SOCKET CONNEC-TIONS	DIMENSIONS MAXIMUM OVERALL LENGTH X DIAMETER	CATHODE TYPE	RATING FILAMENT OR HEATER VOLTS	RATING FILAMENT OR HEATER AMPERES	RATING PLATE MAX. VOLTS	RATING SCREEN MAX. VOLTS	USE Values to right give operating conditions and characteristics for indicated typical use	PLATE SUP-PLY VOLTS	GRID VOLTS	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESIS-TANCE OHMS	MUTUAL CON-DUC-TANCE MICRO-MHOS	VOLT-AGE AMPLI-FICATION FACTOR	LOAD FOR STATED POWER OUTPUT OHMS	POWER OUT-PUT WATTS	TYPE
2A3	Power Amplif. Triode	Medium 4-Pin	Fig. 1	5-3/8" X 2-1/16"	Filament	2.5	2.5	250	-	Class A Amplif.	250	-45	-	-	60.0	800	5250	4.2	2500	3.5	2A3
								300	-	Push-Pull Amplifier	300	-62	Self-bias		40.0	Power Output is for 2 tubes at stated load, Plate-to-plate			5000	10.0	
											300	-62	Fixed-bias		40.0				3000	15.0	
5Z3	Full-wave Rectifier	Medium 4-Pin	Fig. 2	5-3/8" X 2-1/16"	Filament	5.0	3.0	-	-	Maximum A-C Voltage per Plate.....500 Volts, RMS Maximum D-C Output Current.....250 Milliamperes											5Z3
6C6	Amplifier	Small 6-Pin	Fig. 7	4-15/16"X1-9/16"	Heater	6.3	0.3	250	100	Screen Grid Amplifier	250	-3.0	100	0.5	2.0	exceeds 1.5 meg.	1225	exceeds 1500	-	-	6C6
10	Power Amplif. Triode	Medium 4-Pin	Fig. 1	5-5/8" X 2-3/16"	Filament	7.5	1.25	425	-	Class A Amplif.	350	-31.0			16.0	5150	1550	8.0	11000	0.9	10
											425	-39.0	-	-	18.0	5000	1600	8.0	10200	1.6	
24-A	Amplifier Tetrode	Medium 5-Pin	Fig. 6	5-1/32"X 1-13/16"	Heater	2.5	1.75	275	90	Screen Grid Amplifier	180	- 3.0	90	1.7	4.0	400000	1000	400			24-A
											250	-3.0	90	1.7	4.0	600000	1050	630	-	-	
27	Amplifier	Medium 5-Pin	Fig. 5	4-1/4" X 1-9/16"	Heater	2.5	1.75	275	-	Class A Amplif.	135	- 9.0			4.5	9000	1000	9.0			27
											250	-21.0	-	-	5.2	9250	975	9.0	-	-	
42	Power Amplif. Pentode	Medium 6-Pin	Fig. 9	4-11/16"X1-13/16"	Heater	6.3	0.7	250	250	Class A Amplif.	250	-16.5	250	6.5	34.0	100000	2200	220	7000	3.00	42
45	Power Amplif. Triode	Medium 4-Pin	Fig. 1	4-11/16"X1-13/16"	Filament	2.5	1.5	275	-	Class A Amplif.	180	-31.5	180		31.0	1650	2125	3.5	2700	0.82	45
											250	-50.0	250	-	34.0	1610	2175	3.5	3900	1.60	
											275	-56.0	275		36.0	1700	2050	3.5	4600	2.00	
47	Power Amplif. Pentode	Medium 5-Pin	Fig. 4	5-3/8" X 2-1/16"	Filament	2.5	1.75	250	250	Class A Amplif.	250	-16.5	250	6.0	31.0	60000	2500	150	7000	2.7	47
50	Power Amplif. Triode	Medium 4-Pin	Fig. 1	6-1/4" X 2-11/18"	Filament	7.5	1.25	450	-	Class A Amplif.	300	-54.0			35.0	2000	1900	3.8	4600	1.6	50
											400	-70.0	-	-	55.0	1800	2100	3.8	3670	3.4	
											450	-84.0			55.0	1800	2100	3.8	4350	4.6	
56	Amplifier	Small 5-Pin	Fig. 5	4-1/4" X 1-9/16"	Heater	2.5	1.0	250	-	Class A Amplif.	250	-13.5	-	-	5.0	9500	1450	13.8	-	-	56
57	Detector	Small 6-Pin	Fig. 7	4-15/16"X 1-9/16"	Heater	2.5	1.0	250	100	Screen Grid Amplifier	250	- 3.0	100	0.5	2.0	exceeds 1.5 meg.	1225	exceeds 1500	-	-	57
59	Triple-grid Power Amplif.	Medium 7-Pin	Fig. 10	5-3/8" X 2-1/18"	Heater	2.5	2.0	250	-	As Triode Class A Amplif.	250	-28.0	-	-	26.0	2300	2500	6.0	5000	1.25	59
								250	250	As Pentode Class A Amplif.	250	-18.0	250	9.0	35.0	40000	2500	100	6000	3.00	
								400	-	As Triode Class B Amplif.	300	0			Power output values are for 2 tubes at indicated plate-to-plate load.				4600	15.0	
											400	0	-	-					6000	20.0	
75	Duplex-diode High-Mu Triode	Small 6-Pin	Fig. 8	4-17/32"X 1-9/16"	Heater	6.3	0.3	250	-	Triode Unit As Class A Amplif.	250	-1.35	-	-	0.4	-	-	Gain per stage = 50-60			75
76	Amplifier	Small 5-Pin	Fig. 5	4-1/4" X 1-9/16"	Heater	6.3	0.3	250	-	Class A Amplif.	250	-13.5	-	-	5.0	9500	1450	13.8	-	-	76
80	Full-wave Rectifier	Medium 4-Pin	Fig. 2	4-11/16"X1-13/18"	Filament	5.0	2.0	-	-	A-C Voltage per Plate (Volts RMS) 350 400 550 D-C Output Current (Max. MA.) 125 110 135						The 550 volt rating applies to filter circuits having an input choke of at least 20 henries.					80
81	Half-wave Rectifier	Medium 4-Pin	Fig. 3	6-1/4" X 2-7/16"	Filament	7.5	1.25	-	-	Maximum A-C Plate Voltage.....700 Volts, RMS Maximum D-C Output Current..... 85 Milliamperes											81
83	Full-wave Rectifier	Medium 4-Pin	Fig. 2	5-3/8" X 2-1/16"	Filament	5.0	3.0	-	-	Maximum A-C Volt. per Plate...500 Volts, RMS Maximum Peak Inverse Voltage...1400 Volts Maximum D-C Output Current....250 Milliamperes Maximum Peak Plate Current..... 800 Milliamp.											83
112-A	Amplifier Triode	Medium 4-Pin	Fig. 1	4-11/16"X1-13/16"	D-C Filament	5.0	0.25	180	-	Class A Amplif.	90	- 4.5			5.0	5400	1575	8.5			112-A
											180	-13.5	-	-	7.7	4700	1800	8.5	-	-	
845	Amplifier Triode	Jumbo 4-Pin	-	7-7/8" X 2-15/16"	A-C Filament	10	3.25	1250	-	Class A Amplif.	1000	-147	-	-	75	1800	3000	5.0	7500	23	845
866	Half-wave Rectifier	Large 4-Pin	Fig. 11	6-5/8" X 2-7/16"	Filament	2.5	5.0	-	-	Maximum Peak Inverse Voltage...7500 volts Maximum D-C Output Current.....0.25 amperes											866
868	Phototube	Small 4-Pin	-	-	See Manufacturer's Specifications																868
920	Phototube	Small 4-Pin	-	-	See Manufacturer's Specifications																920

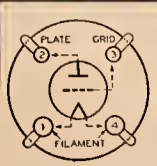


FIG.1

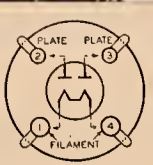


FIG.2

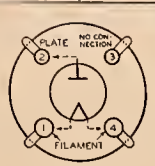


FIG.3

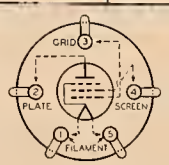


FIG.4

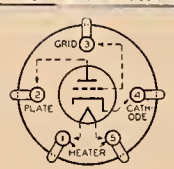


FIG.5

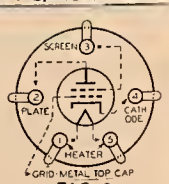


FIG.6

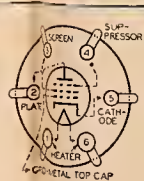


FIG.7

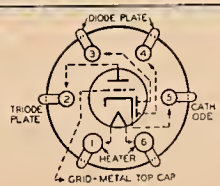


FIG.8

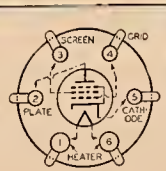


FIG.9

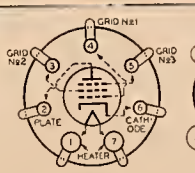


FIG.10

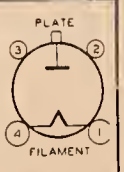


FIG.11

SOCKET connections shown are bottom views of the socket. Pin numbers on socket diagrams are according to the system standardized by the Radio Manufacturers Association.

Maximum peak inverse voltage characteristic of a rectifier tube is the highest peak voltage that a rectifier tube can safely stand in the direction opposite to that in which it is designed to pass current.

In single-phase, full-wave circuits with no condenser across the output, this voltage is approximately 1.4 times the RMS value of the plate voltage applied to the tube.

In single-phase, half-wave circuits, with condenser input to the filter, the peak inverse voltage may be as high as 2.8 times the RMS value of the applied plate voltage.

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SUPREX ARC MAGNIFICATION RATIO

By *G. S. PATTERSON*
MEMBER, PROJECTIONIST L. U. 513, TULSA, OKLAHOMA

One of the first to complain about incorrect magnification ratios of Suprex lamps, the author of the appended article was invited to describe certain mechanical changes made on his lamps which, he asserted, overcame this difficulty. This article is his response. Obviously there exists some difference of opinion between Mr. Patterson and I. P. as to the exact nature of this lamp trouble, as his article shows. Incidentally, the delay attendant upon publication of this contribution impelled Mr. Patterson to address a most interesting letter to I. P. which appears elsewhere in this issue under the heading, "Letters to the Editor"—an expression of opinion which is recommended to our readers.—*Editor.*

FOR any discussion to be consistent and some definite conclusion arrived at, the participants must stick directly to the question. I. P.'s first reference to this topic of magnification ratio stated flatly that there was "extreme difficulty experienced by projectionists in *holding the Suprex arc spot on the aperture.*" This has been the basis for my discussion of this matter.

Subsequently, however, I. P. diverged and ascribed the trouble to "unevenness of field." The statement "holding the spot on the aperture" is self-explanatory; and having made this statement I. P. should not try to run away from it. I can hold my hand on a lamphouse without covering it; but to hold one object on another and to *cover* an object involves two separate problems.

For argument's sake, I will assume that the magnification ratio of my lamps was incorrect when they were installed. After they had been in use for a short time it was necessary to fix the lamps to hold the spot on the aperture, rather than return them as did one complainant, Mr. Chick of Glenside, Penn., because he experienced so much trouble with them.

No Margin for Variation

Assuming that with 7 mm. carbons the magnification ratio isn't great enough to cover the aperture diagonally, and that the 8 mm. just covers the aperture, isn't it absolutely essential that all other factors must be perfect to hold the spot in as near the center position as possible, there being no margin for variation? If the other factors are not perfect, isn't it logical that trouble will be experienced in holding the spot on the aperture? It is those factors about my Peerless Suprex lamps that are not perfect, thereby making it necessary for extra mechanical contrivances to hold the small spot on the center of the aperture at all times.

The Suprex lamp has a very high point of efficiency and if perfect operating conditions are not maintained, its efficiency drops off at a faster rate than any lamps in my experience. It is absolutely necessary to maintain a positive crater with its outside circle in parallel with the outside circle of the reflector. The positive crater must be held in the center of the reflector at all times, and the negative carbon must be in a constant fixed relationship with the positive carbon.

With those facts in mind, and my lamps failing to accomplish those conditions, it was necessary to make a V-shaped guide out of heat-resisting and non-oxidizing metal to hold the positive carbon steady; the half square guide that came with the lamps began to peel off shortly after they were installed, thereby allowing the positive carbon to float. After about eight months there is fully one-eight inch clearance on all sides where the positive carbon would be supported—that is, without the new V guide.

Positive 'Floats' About

Now, if you don't believe that plenty of trouble would be experienced in holding the spot on the aperture when the positive crater is allowed to float around in the one-eighth clearance, I hereby extend an invitation to visit Tulsa for an actual demonstration which should be convincing, even though my written explanation fail.

The V-guide is about 4 inches long, ¾ inch wide and about 3/16 inch thick, and is mounted on the back side of the old guide and held into position by two screws holding the old guide. It is advisable to make slots in the guide for adjustments.

When the lamps arrived there was a small flat spring on the negative carbon arm assembly to hold the negative carbon in position. This spring is only effective during a portion of the travel of the negative arm assembly. After that, it would float around and get out of alignment with the positive carbon, resulting in an ill-formed crater.

A small piece from a wire coat hanger and a flexible spring from a curtain roller did the trick. The flat spring was removed and the coil spring fastened to the negative carbon clamp shaft handle so as not to interfere with its action. An L-shaped heavy wire was mounted to the main casting just above the oil cup, and the spring attached so as to maintain as nearly as possible the same amount of tension throughout the complete travel of the negative arm assembly. Insulation between the negative carbon and the casting must be maintained, which was accomplished by a small fiber link between the wires and the spring.

Shims Eliminate Play

To further maintain a perfect crater, shims were necessary to take the surplus play from between the positive post casting and the positive carbon clamp head. Too much draft in the lamphouse will also have serious effects upon the crater.

In burning the positive as short as possible, it is necessary to hold them at the edge of the positive carbon clamp, with the result that it was almost impossible to set it in the correct position. A small piece of tin ¼ inch wide and pin-pointed at one end was fastened in an upright position to the positive post casting, just to the right of the pivoting pin. Another piece of similar construction was fastened to the back side of the positive carbon clamp and bent to where their points match when the positive carbon is properly aligned and the crater correctly formed.

With those mechanical contrivances it is possible to HOLD the spot on the aperture at all times. The only trouble experienced now is a slight variation in carbons with the result that the positive crater occasionally burns off to one side. To offset this I have designed a method of adjusting the negative carbon by knob adjustments like those used to adjust the reflector, but have not installed them yet.

The foregoing necessary changes substantiates I. P.'s contention that the Suprex lamps were rushed onto the market by high-pressure salesmen with a competitive spirit rather than await to submit a finished product. The exhibitor who was a victim of such schemes and placed inferior lamps in projection rooms should demand that the manufacturers correct the deficiencies free of charge.

It was my original contention that the trouble experienced in holding the spot on the aperture could be overcome by mechanical devices and I believe my explanation has been convincing. The manufacturers should give a little more time to the finer mechanical features of their product.

THE W. E. 86-TYPE AMPLIFIER, UNIT OF THE 'MIRROPHONIC' SYSTEM

By *AARON NADELL*

THE circuit of Fig. 1, like that of W. E. 91-A amplifier traced in last month's issue, includes special provisions for suppression of harmonic distortion. In the present circuit, however, reverse feedback is not used for that purpose, but the same result is accomplished by novel arrangements introduced into the return line between the primary of the output transformer and the filaments of the output tubes. These arrangements are traced in detail herein, and constitute the "harmonic equalizer."

The present amplifier also uses a plate current meter calibrated in percentage and not in milliamperes, and reading (through a rotary switch) the current of eight separate circuits in terms of percentage of the correct value. The necessity for noting or remembering the correct values of eight circuits is thus eliminated, and possibilities of a mistake in operation are reduced.

Line power enters Fig. 1 through Terminals 15 and 16, at the bottom of the drawing, completing its circuit through switch D-1 and through the primary of the power transformer.

The left-hand secondary of the power transformer supplies the heaters of the first three tubes. Those heaters are wired in parallel. From the right-hand end of that secondary trace up, left and up to the heater of VT-3; thence down and right to the left-hand end of the same winding. Beginning again at Terminal 9 of the same secondary, trace up, left, and up to the first point of junction; then left and up to the heater of VT-2, and down, right and down as before, to transformer Terminal 1. Again beginning at transformer Terminal 9, follow up, left, up to the first point of junction, left as far as possible, up, through the heater of VT-1, down right as far as possible and down to transformer Terminal 1.

The center tap of this winding, transformer Terminal 8, serves as a means of reducing a.c. hum in the sound. From that center tap trace up, left and up to a point of junction. From that point straight up to the cathode of VT-3; left and up to the cathode of VT-2; still further left and up to the cathode of VT-1. The effect is to connect those cathodes [through the resistors in series with them, R-2, R-3 and R-4] to the mid-points of their respective heaters.

Moving right along the power transformer to transformer Terminal 4, trace up, right, up, right, up and right to the filaments of VT-4 and VT-5; and from those filaments right, down, left and down to Terminal 6 on the same winding. This winding, then, lights the filaments of the output tubes; and its center tap, at Terminal 5, serves as the return for the plate current of those tubes.

The extreme right-hand secondary of the power transformer lights the filament of the full-wave rectifier tube, VT-6.

The Plate Power Circuits

From the positive source of the rectifier circuit—the rectifier tube filament, or transformer Terminal 14—trace right, up as far as possible through filter choke L-2, left to the first junction; up, right through .424-ohm meter resistors, and through the output transformer to the plates of the output tubes. From plates to filaments, and then down, left and down through the filament supply leads to transformer Terminal 5; then up through the 570-ohm tapped grid bias resistor, R-5; then right and down to the center tap of the plate secondary, transformer Terminal 11, which is the negative terminal of rectifier circuit.

From transformer Terminal 14 to the right, up through L-2, left past C-12 filter condenser to the next point of junction, and then up through R-11, R-26 and R-10 and left to the plate of VT-3. From the cathode of that tube down through the grid bias resistor R-4, to a junction just below and to the right of L-1; then right to the second junction and down to transformer Terminal 11.

From transformer Terminal 14 to the right, up through L-2, left through choke coil L-1 and resistor R-23 to the next junction; up through R-25 and R-7 to the plate of VT-2. From the cathode of that tube down through R-3 as far as possible, and then right to the fourth junction and down to Terminal 11.

From Terminal 14 to the right, up and left as before, continuing left as far as possible; then up through R-14, R-24 and R-1 to the plate of VT-1. From the cathode of VT-1 down through R-2 and right to the fifth junction and down to Terminal 11 as before.

External Supply Circuits

Ten volts for the exciter lamps are supplied through Terminals 13 and 14, at the bottom of the drawing. This power is drawn from the same transformer secondary that supplies the heaters of the first three tubes.

High voltage is supplied through Terminals 7, 8, 9 and G-4, at the right of the drawing. From transformer Terminal 14 trace to the right and up through L-2 to the first junction; then left through Resistor R-6 and down to transformer Terminal 11. R-6 is connected across the full voltage output of the rectifier circuit and, being tapped, serves as a voltage divider. Terminal 7 is connected, through the meter resistor R-28, to the full voltage output of the rectifier. (This terminal supplies P. E. C. voltage through an external filter unit.)

Terminal 8, however, taps off only a portion of the voltage-drop across R-6, and Terminal 9 even a smaller portion.

Important Notice

The W. E. 86-type amplifier described in the accompanying article uses a "harmonic suppressor" circuit to eliminate distortion. "Harmonic equalizer" is the preferred term for this device. The foreword to the article describing the W. E. 91-type amplifier (I. P. for Nov., p. 19) stated erroneously that the 91-type utilized the harmonic equalizer. This is not the case; and the facts were stated correctly in the article itself.

***The 91-type amplifier uses "reverse feedback" to eliminate harmonic distortion, and not the harmonic equalizer, which is a different device and is described in detail in the accompanying article. A comparison of both these articles will serve to emphasize this difference in suppressor circuits.*—Editor.**

The return from all three external circuits is through Terminal G-4; then left to the first junction and down to transformer Terminal 11, or negative. Terminal G-4 is also grounded to earth.

Plate Current Meter

The blades of the double-pole rotary switch D-2, seen just below the rectifier tube VT-6, connect to the plate current meter through Terminals 5 and 6 at the lower right-hand corner of the drawing. By means of the switch the meter can be made to indicate the current flowing in any of eight different circuits. Each of the currents to be read by this meter has been made to flow through a resistance of suitable value. The meter itself is a voltmeter, reading the voltage-drop across the meter resistor to which it is connected by switch D-2. The value of each resistor is so chosen that when the correct current flows through it the meter will read 100%.

The meter, as drawn, is connected to Resistor 24. The wires running to that resistor have been omitted by the draftsman for the sake of clarity. Resistor 24 will be found in series with the plate of VT-1: from that plate trace up, right and down through R-1 to R-24. Note that the value of the resistor is 19.25 ohms.

R-25 serves the same purpose in the plate circuit of VT-2, and can be found by tracing similarly from that tube. Note that the value of this resistor also is 19.25 ohms.

R-26 will be found similarly placed in the plate circuit of VT-3, and likewise is 19.25 ohms. Thus, the d.c. plate current through the first three tubes should be identical. The plate current through VT-4 and VT-5 is, naturally, much higher, and the values of the meter resistors correspondingly lower. The resistors are R-30 and R-31, each 0.424 ohms, shown just left of the primary of the output transformer.

R-27, R-28 and R-29 read the current to the external leads through amplifier Terminals 7, 8 and 9 at the right of the drawing.

Grid Bias Circuits

From the cathode of VT-1 trace down through R-2 (2600 ohms), which is the bias resistor for that tube. Plate current returns to negative through that cathode resistor. Its lower end is therefore negative with reference to its upper end and to the cathode of the tube. From the grid of VT-1 trace up to amplifier Terminal 1 and to the jumper indicated by the dotted line. If the jumper is set at amplifier Terminal 3, trace down through R-16 to the upper end of R-17. If the jumper is set at Terminal 4, trace down and left to the upper end of R-17, down through R-17 and right through R-9 to the lower, or more negative, end of R-2.

From the cathode of VT-2 trace down through R-3 (2600 ohms); down and left through R-22, left and up through R-15, and either straight up to amplifier Terminal 8 or right and up to Terminals 10, 11 or 12. From whichever of these terminals is connected to the arrowhead jumper, right and down to the grid of VT-2.

From the cathode of VT-3 down through R-4 (also 2600 ohms) left and up through R-8, and either straight up to Terminal 16 or right and up to Terminal 18. From either of these terminals to the right to grid.

It will be seen that not only are the plate currents of these tubes the same, but their grid bias is the same, since in each case the identical current flows through bias resistors of identical value, 2600 ohms. The other resistors in series with the grids, of course, have no effect upon the fixed bias, since no d.c. flows through them and there is no d.c. voltage-drop across them.

From the filaments of VT-4 and VT-5, trace down, left and down to power transformer Terminals 4 and 6. Thence to power transformer Terminal 5, and straight up to the grid bias resistor, R-5, total value 570 ohms. The tap on that resistor, which divides it into sections of 60 ohms and 510 ohms, forms part of the harmonic equalizer, and will be discussed in detail subsequently. The upper end of R-5 is negative and may be traced up, right and down to the negative d.c. source, transformer Terminal 11. From the upper or negative end of R-5 trace left through R-13, up, right, up through R-12, and right, up and left to the mid-point of the secondary winding of coupling transformer T-2. Through the two halves of that winding to the grids of the two tubes.

The Speech Circuits

Speech a.c. enters Fig. 1 at the input transformer, T-1, shown at the right top of the drawing. This transformer is completely shielded to avoid inductive pick-up of hum from the power circuits. The alternating voltage generated in the secondary of T-1 is impressed across R-16 and R-17, which total 500,000 ohms. The potential difference across 500,000 ohms is impressed upon the grid of VT-1, if the jumper is set at Terminal 3; but if the jumper is set at Terminal 4, the grid is swung only by the voltage developed across 280,000 ohms. The drawing indicates that the difference in sound level amounts to 5 db. The return is from the cathode of VT-1 to the left, down C-1 and right to the bottom of R-17.

Taking the plate and cathode of VT-1 as the poles of a generator of speech a.c., the load upon the tube may be traced from the plate to the right, down through R-1 and R-24, left through C-3, up through C-2 and right to cathode. A parallel circuit exists which may be traced from the plate of VT-1 up and right through the jumper; right through C-5, right through the fixed jumper to Terminal 8; down through R-18, R-19, R-20 and R-15; right and up through C-14, right through C-2; down as far as possible, left as far as possible; up, left, up through C-2 and right to cathode.

Resistors R-18, R-19, R-20 and R-15 constitute a tapped voltage divider, any tap of which may be connected to the grid of VT-2 through Terminals 8, 10, 11 or 12. The return to the cathode of VT-2 is to the right from the bottom of R-5 and up through C-14 as far as possible, then right to cathode. The maximum potential difference, and therefore maximum volume, is coupled to VT-2 when Terminal 8 is used. The drawing states that if the arrowhead jumper is connected, instead, to Terminal 10, the loss in volume will be 10 db; if to Terminal 11, the loss is 20 db; while a 30 db loss results when the arrowhead jumper is tied to Terminal 12.

From the lower end of R-15 the line to the cathode of VT-2 runs to the right, up through C-14 and then right.

The load across VT-2 may be traced from the plate down through R-7 and R-25, and down as far as possible through C-4 and C-7. Thence left to the next junction, up, left through C-2, and up and right.

From the plate of VT-2 trace a parallel path up, right, up, right, down and right through C-6; then up and right through a fixed jumper to Terminal 16. From that terminal down through R-21 and R-8 and right to the lower end of R-4; down to the next junction, left to the second junction, and up to the cathode of VT-2 as before.

R-21 and R-8 total 500,000 ohms, and the full voltage-drop through that resistance is connected across the grid and cathode of VT-3 when the grid jumper of VT-3 is set at Terminal 16. When that jumper is set at Terminal 18, the grid of VT-3 is swung only by the drop across 160,000 ohms, and the difference in volume is 10 db.

From the cathode of VT-3 trace the return left, down through C-2 and left to the lower end of R-8.

Checking with the drawing, it will be seen that a total variation in volume of 45 db can be effected by suitable connections of the grids of VT-1, VT-2 and VT-3.

From the plate of VT-3 trace the plate load right, down through R-10 and the meter resistor R-26, down, left, up through C-8; left, up through C-2, and right. Trace the parallel path from the

plate of VT-3 right to the primary of T-2, down through that winding, left, up through C-9, and right to cathode.

From the two outside terminals of the secondary of T-2 trace to the right to the grids of the two output tubes. From the filaments of those tubes follow the filament leads down, left and down to the second secondary of T-4. From the center-tap of that secondary trace up, left, up through C-11 as far as possible; then right, up through R-12, right, and up and left to the center-tap of the secondary of T-2.

From the plates of VT-4 and VT-5 trace the load upon those tubes to the right to the output transformer primary; from Terminals 4 and 5 of that winding left through the two small meter resistors, then down as far as possible; left to the third junction, down and right through C-10-C-13; down through the 60-ohm section of R-5 to the mid-point of the second secondary of T-4; then back along the filament leads to the filaments of VT-4 and VT-5.

The output transformer secondary, like the input transformer primary, is center-tapped to provide a choice of coupling impedances.

The 'Harmonic Equalizer'

The harmonic content, or harmonic distortion of an amplifier, which impairs tone quality and causes sound to seem unnatural, is created by the inherent nature of amplifying tubes. The pattern of the output sound wave never matches exactly the pattern of the input sound wave. The extent of the distortion created by tube action depends upon the conditions under which the tube is operated. The grid bias is among the operating conditions that have an important influence upon the accuracy of amplification. But with the most favorable of operating conditions there is always some degree of distortion which is manifested as unnatural sound.

The input and output wave patterns of an ampliying tube can be studied in a number of ways, and analysis reveals that the effect of the distortion now being considered is exactly the same as if certain extraneous frequencies were introduced into the sound by the action of the tube. These frequences bear a definite arithmetical relation to the original or fundamental wave, and are called "harmonics."

If the fundamental frequency be, say, 500 cycles, there will be a second harmonic of 1,000 cycles, a third harmonic of 1500 cycles, and so on. Harmonic distortion is that action, on the part of the amplifying circuits, that alters the pattern of the sound frequency in a way which corresponds exactly to the addition of harmonic frequencies. Conversely, if suitable electrical means are used to draw off or filter off harmonic frequencies, the distortion is removed and sound resumes its original clarity.

A further discussion of harmonic distortion, and of one method for removing it (reverse feedback) was discussed in the last issue of I. P. (Nov., p. 19).

The amplifier of Fig. 1 of the present article also incorporates means for removing harmonic distortion but the method in no way resembles reverse feedback. A different arrangement is used to achieve the same result.

The W. E. 91-A amplifier traced herein last month used a single-end output stage instead of push-pull output. Reverse feedback, which removes all harmonic distortion, made this possible without sacrifice of quality. The 86-type amplifier now under consideration gets rid of one-half the harmonic distortion [the second and other even harmonics] by the common device of a push-pull output stage. The even harmonics balance out in the primary of a push-pull output transformer, where they meet 180 degrees out of phase. The third and other odd-order harmonics, however, remain in ordinary push-pull circuits, and a certain amount of distortion appears in the sound.

The "harmonic equalizer" in Fig. 1 consists of the 60-ohm portion of the grid bias resistor, R-5, and the 16 microfarads of C-10-C-13. These two units are in series with the return from the center-tap of the primary of the output transformer to the filaments of the output tubes. Trace again from Terminals 4 and 5 of the primary of T-3 through the meter resistors (which are too small in value to be considered); thence down, left to the third junction, down, right through C-10-C-13, down through 60 ohms to the center-tap of the second secondary of T-4, and then back to the filaments of VT-4 and VT-5.

Sixty ohms and 16 microfarads constitute the only impedance in this line.

The second and other even-order harmonics cannot manifest themselves in the primary of a push-pull output transformer, where they meet out of phase and cancel, but commonly appear as voltage in the return between the center-tap of that primary and the output filaments. They also appear in the space of the output tubes themselves.

The very low impedance of 60 ohms in series with 16 microfarads, in the present circuit, prevents the even-order harmonics from developing any appreciably large voltage drop in the filament-to-primary-center-tap lead, and thus concentrates them almost entirely in the space of the tubes. But in the tubes they react with the fundamental frequency to produce third- and other odd-order harmonics which are 180 degrees out of phase with the odd-order harmonics already present there. The result is, that while even-order harmonics are kept from the speakers by meeting out of phase in the primary winding of the push-pull output transformer, odd-order harmonics are cancelled in the tubes themselves by the generation, within those tubes, of the identical harmonic frequencies in reverse phase.

The action in the tubes is very similar to that which takes place in the mixer,

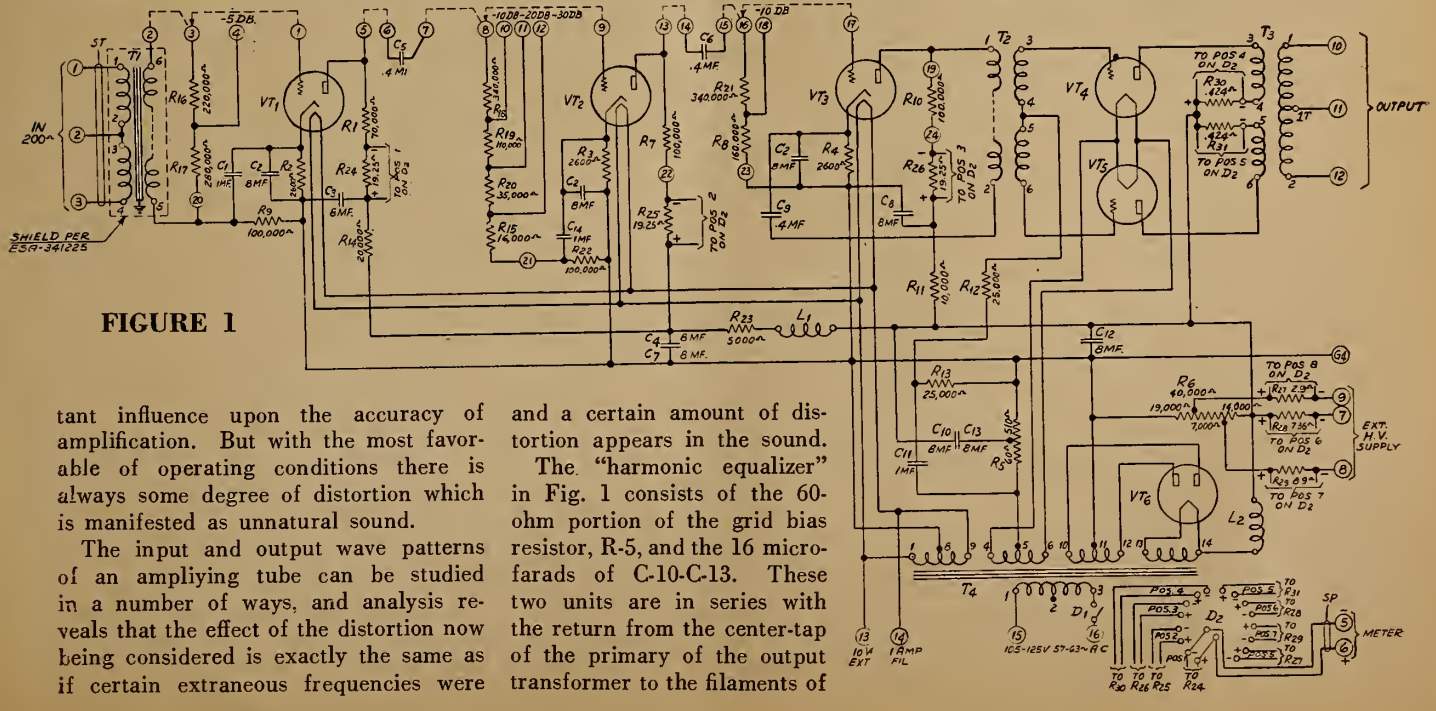


FIGURE 1

or converter, tube of a super-heterodyne radio receiver, in which two frequencies are made to "beat together" to produce other frequencies. Thus, 500 cycles and 1000 cycles "beat" to produce a difference frequency of 500 cycles (difference frequencies are the ones used in radio receivers) and a sum frequency of 1500 cycles. The sum frequency is used in Fig. 1 to cancel the 1500-cycle, third-harmonic distortion which is already present.

The critical factor in this circuit is the value of the lower half of R-5, 60 ohms. At any other value the third harmonics generated in the output tubes would either be too weak to cancel the original distortion entirely, or so strong as to more than balance it and thus introduce distortion themselves. It is imperative, therefore, that this value, as well as the 16 microfarads of C-10-C-13, be maintained undisturbed in any work that may be done on the amplifier, if the quality of its output is to be preserved.

THE W. E. 87-TYPE AMPLIFIER

THE a.c. power input enters this 87-type amplifier (Fig. 2) at the bottom of the drawing, completing its circuit through Switch D-3 and Fuse F-1. D-3 is a familiar type of switch, having three positions. In the "OFF" position, Terminals P, F and L all are open. In the F position, Terminal L is paralleled to Terminal F, closing the circuit to the left-hand power transformer, T-3. This transformer, as will be seen, lights all the filaments of the amplifier. When the tubes are warm, D-3 is thrown to the next position, Terminal P is added to the line, and the circuit is closed to the plate power transformer, T-4, through the safety-door switch, D-4.

T-3, the filament power transformer, has three secondary windings. The left-hand secondary heats the filament of amplifier tube V-1. The center secondary heats the filament of V-2. From the end terminals of these windings trace directly upward to the filaments of the amplifying tubes. These separate filament windings provide a simple arrangement, to be traced in detail, for testing the plate currents of V-1 and V-2 individually. The right-hand secondary of T-3 heats the filaments of the two rectifier tubes, V-3 and V-4.

Plate Power Circuits

Plate power is derived from the secondary winding of transformer T-4, and that winding is, of course, energized only when switch D-3 has been thrown to "P" position, and when the safety switch, D-4, is closed.

From whichever end of the secondary of T-4 is positive at the moment, trace to the corresponding rectifier tube plate, then to the filament of the same tube, and then to the center-tap of the right-hand secondary of T-3. From there straight up to L-1, through L-1, right and up through the upper portion of L-2, and right to the center-tap of the primary of the output transformer, T-2.

From the two ends of that winding to the plates of V-1 and V-2, and then to the filaments of those tubes, and to their respective filament transformer secondaries, the left-hand and center secondaries of T-3. From the center taps of those secondaries, left, and to the blades of D-1 and D-2.

From the blades of those switches trace upward through R-9 and R-10, both of which are 1.44 ohms. [Some drawings of this amplifier show R-9 as 144 ohms, which is incorrect.]

From the upper ends of R-9 and R-10 the plate currents of V-1 and V-2 continue up and join just below R-4, the grid bias resistor. Trace through R-4 and then right to the fifth junction; then down to the center tap of the secondary of Transformer T-4, completing this circuit.

The Safety Resistor

C-3 and C-4, seen above and just left of choke coil L-1, are the filter condensers of this circuit and constitute six microfarads bridging across the rectifier output line between L-1 and L-2. The lower portion of Coil L-2 is never used in this particular amplier.

Resistor R-5, 1 megohm, shown be-

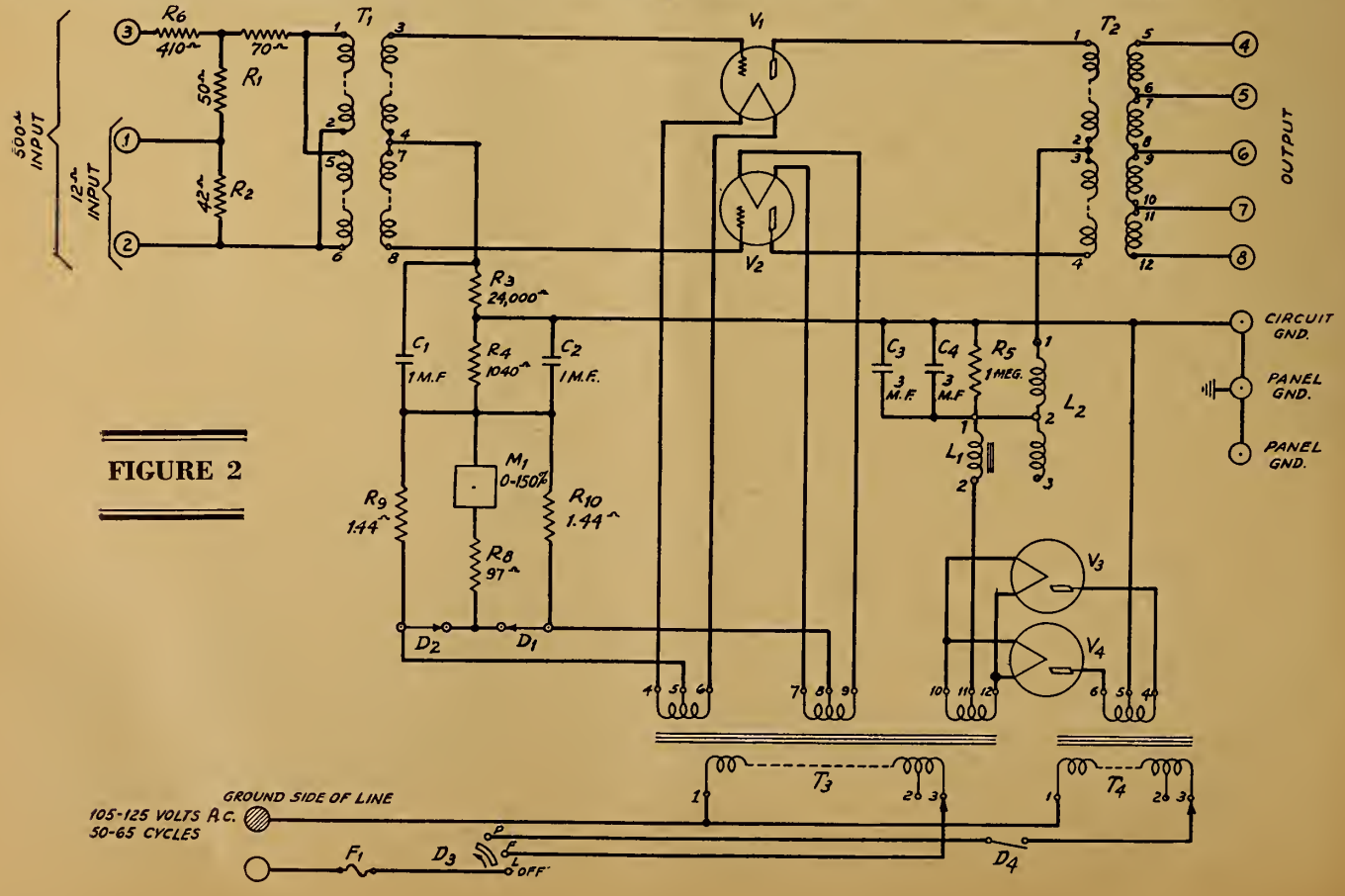


FIGURE 2

tween condenser C-4 and the upper portion of Coil L-2, provides protection against the charge normally stored in condensers C-4 and C-3. Projectionists are aware of the need for short-circuiting filter condensers before working on any power amplifier. The voltage stored across them while the amplifier is operating has no means of equalizing itself when the amplifier is turned off, but remains on the condenser plates as a charge and constitutes a definite hazard.

In the present circuit that charge is maintained by the output of the rectifier tubes as long as the amplifier is working, since R-5 is too high in value to constitute a short-circuit. But when the plate power is switched off, either at D-3 or at the door switch D-4, the charge upon the condensers equalizes itself in a very short time by means of the small current that will flow through R-5.

Plate Current Meter

The plate current meter is shown as the rectangle, M-1, midway between the 1.44 ohm resistors, R-9 and R-10. In series with that meter is R-8, 97 ohms.

Under normal circumstances the switches D-2 and D-1 are closed, as shown, and the current between the blades of those switches and the lower end of R-4 will flow almost entirely through the low resistances, R-9 and R-10, which serve as shunts for this milliammeter. A small percentage of the current will complete its path through R-8 and the meter. With the switches closed, as drawn, the meter indicates the plate current of both amplifier tubes, V-1 and V-2.

But if Switch D-2 be opened, no part of the current of V-1 can find its way to the meter. Its path must be completed entirely through R-9. The meter then reads the plate current of V-2 only. Conversely, if Switch D-1 be opened, all of the current of V-2 completes its circuit through R-10, and the meter reads V-1 current only. The meter is calibrated in percentage.

Plate currents of both tubes come together in parallel just above the meter and flow together through R-4, then right to the fifth junction and down to the negative terminal of the rectifier, the center-tap of the secondary of Transformer T-4. The upper end of R-4 is thus negative with respect to the filaments of V-1 and V-2. It is connected, through R-3 and the secondary of the Input Transformer T-1, to the grids of those tubes.

The Speech Circuits

Speech, a.c. enters this amplifier at the upper left-hand corner, and may be drawn from either a 500-ohm or a 12-ohm line. The network of resistors shown just left of the input transformer serves to match a line of either value to the primary of that transformer, the two coils of which are connected in parallel.

The upper and lower ends of the secondary of that transformer go to the grids of the two push-pull tubes. The return, from the filaments of those tubes, should be traced as before to the filament secondaries on transformer T-3 and thence to the meter. From the upper end of the meter the circuit is: left, up through C-1, right, up and left to the center tap of the input transformer primary.

The plate speech current may be traced from the plates of the tubes to the primary of the output transformer; from the center tap of that primary down through L-2; left, up through C-3 and C-4; left, and down through C-2 to the meter or filament circuit. R-3, 24,000 ohms, is shown just above R-4, prevents the plate current from returning to the grid circuit.

Provision is made for testing the plate current of the push-pull amplifier tubes, and for matching same, without lifting them from their sockets. This idea should be extended to include rectifier tubes. Mr. Projectionist then need not scorch his fingers.

• Letters to the Editor •

More General Exchange of Ideas Would Be Helpful

My compliments to I. P. on a noticeable improvement in recent issues of this great aid for projectionists. Recent articles have been more general in scope and much more interesting to the average worker. I would welcome more correspondence from the boys in the field—just to get their ideas on problems common to all of us. Most of our fellows hesitate to ask for aid, because they consider this an admission of ignorance. The boys should realize that a frank and open discussion of problems in I. P. would result in great progress by the craft. Some men discover little tricks, invent odd gadgets, run across faults in equipments, etc., but instead of publicizing such things for the benefit of others, they keep it a secret.

One of our men recently sprung a new one. His theatre had been treated with a material called rock-wool or spun-glass. This fellow swiped a piece of this material and placed it in the drip pan under his Suprex arc. Presto; he diminished pitting almost to the vanishing point. Another man here bought new clock-spring De Vry reels, the hubs of which wore out in a couple of months. His complaints resulted in De Vry promising to replace all such reels which prove unsatisfactory.

Now, these men thought that these matters were of no general interest or value. I say, why not let all the boys in on the secret?

J. A. Campbell
L. U. 316, Miami, Fla.

Suprex Arc Lamp Changes; I. P. Editorial Policy

It becomes necessary for me to again write to you regarding my letter of several months ago, in which I defended my contentions and explained my method of overcoming the troublesome feature of "holding the Suprex arc spot on the aperture." I am convinced that your failure to publish my letter is not an oversight, since I have written you two letters (this is the third) requesting that you publish my original letter. You deny my contention, and request further data; then you fail to publish the data.

Your attitude reminds me of a little boy standing on his front porch and calling his playmate a liar; after which he runs into his house.

Unfortunately, the difficulty centers about a widely advertised product which occupies a lot of advertising space in I P., and also in that I mentioned the name of the lamp in my statement. While I don't desire to harm this product, I notice you deleted the name of the lamp in my first letter.

Perhaps my explanation was too convincing anent the trouble with this particular lamp. I. P. professes to be a craft paper, serving the reader first and then the advertiser. If your real interest is as you profess, there is no reason why you should not publish my explanation, which is intended to aid the craft and assist the manufacturer to better his product. Surely my explanation is more interesting and informative to the craft than Mr. Hertner's attempt in I. P. for November to defend his product.

Following your challenge in the August issue for me to supply more details, I accepted immediately and filed the material in ample time for the next issue. Your failure to publish this data leaves an impression in the minds of your readers that you called my hand, thus proving that I was talking through my hat.

I have nothing to sell, nor do I seek any gain. Fair play requires that you not deny publication of my explanation after questioning my ability.

G. S. Patterson
L. U. 513, Tulsa, Oklahoma.

Extracted from the files, Mr. Patterson's contribution is published elsewhere in this issue under the heading, "Suprex Arc Lamp Magnification Ratio." I. P. still maintains that this "explanation," while interesting, does not have the merit of general applicability. It is not the function of projectionists to engage in extensive mechanical alteration of a product, which should be done at the factory.

Moreover, I. P. deleted the lamp name from Mr. Patterson's original letter because the deficiencies cited were not confined to one make of Suprex lamp but applied to

all of them—thus making unfair the citation of only one manufacturer. The job at hand, as I. P. saw it and still sees it, was to effect improvement on the factory end. In any event, the name of the lamp appears in the aforementioned article, manifestly unfair though it be.

I. P. welcomes contributions from readers on practical projection; yet the final decision as to their availability for publication must necessarily rest with the editor. If Mr. Patterson feels that he has been treated rather shabbily in this instance, I. P. can only express its sincere regrets.

Anent the charge that consideration of advertising revenue influenced the decision not to publish Mr. Patterson's contribution, this statement is so manifestly unfair and so at variance with the facts as to require scant comment here. It is our opinion that from among the thousands of I. P. readers Mr. Patterson would find it extremely difficult to find even one or two who would agree with him in this opinion.—Ed.

Lax Exchange Inspection No Aid to Good Projection

I can't resist congratulating you on your recent article relative to projection room fires and the deaths resulting therefrom. Your reference to film that is "run to death" was particularly acute. Recently we had a fine example of this. We received a print that was literally hacked to pieces, in addition to having long sections of dialogue missing.

We wired for another print, which was in worse shape than the first one, except that no dialogue was missing. Evidently when it was rewound (it had the exchange seal although not initialled) the film was allowed to slap from side to side on the reel. It was then shipped in an upright case, with the weight of other reels on the bottom reels, which were in the worst condition. The edges were broken, necessitating the removal of much footage in order to ready for projection.

Believe it or not, we elected to run the first print. Such an exchange should be penalized, I don't know by whom. Most exchanges think only of squeezing the exhibitor and of running a print to death until it falls apart. The remainder of your article was excellent and should be seen by every projectionist and manager.

H. B. Smith
West Springfield, Mass.

Recommends Acetate Film as Protection Against Fire

Your article "Five Recent Fire Deaths Stress Poor Equipment and Lax Regulation" in your last issue is commendable. I have spent more time and money in preaching the same subject than anyone else in the industry, and thereby have made some formidable enemies, including the film manufacturers and some producers.

For years, I attended regularly the International Fire Marshall's conventions. I talked with the underwriters and also the local and state officials on the subject. I finally gave up the fight, as, after all, it's the public's concern more than my personal feeling as to what they want to do about it. I kept newspaper clippings on the subject for years—and the deaths from film fires run into hundreds; but the public seems unconcerned as long as it doesn't strike home.

When I first started on the subject in 1914 I was, of course, more interested in the non-theatrical use of film than in the theatrical end of it; but I claimed then and do now claim that it was short-sightedness on the part of manufacturers of film to use nitrate base instead of acetate stock; that insurance costs, restrictions, vaults and, more important, the loss of life, many many times offset the trifling increase of cost of the acetate stock; and that the increase in the sale and consequent profit of safe film would so far outdo the nitrate stock that there would be no comparison.

Eastman argued that everything is lovely now and we don't need it. No one but myself raised their voice in supporting acetate film. The moving picture film fires are not the only ones we have had. Hospitals and film exchanges have been blown up time and again, and still the industry tolerates inflammable film.

You will never eliminate carelessness or accidents in the handling of film—the cause of 99% of the film fires. The answer is, make the film safe for the entire industry and simultaneously for kindred uses. That's the answer.

Herman A. DeVry
H. A. DeVry, Inc., Chicago.

Given a good print, ample manpower, and projection equipment that is up to snuff, almost all theatres could compile an imposing safety record from film fires, even with nitrate stock. Deficiency in any of these respects constitutes as much if not more danger than carelessness.—Ed.

A Man Who Wants Action

Your remarks in the October issue concerning "simplifying" the I. P. editorial content interested me when I first read it, and after reading the remainder of this issue, I still feel that you are hitting just about the right level of projectionist education and intelligence. Many of the articles are just above my level [of both e. and i.] and many far above, but as yet there has never been any too low.

That may not prove very much, except that one reader feels that if the level is just above him, it will encourage him to reach for that level, and highly approves of such a condition. The standard seems to remain about the same and I know that study has made your magazine much more readable, understandable and therefore more valuable.

The S. M. P. E. Conventions would be much improved by additional time for discussion of papers and for examination of equipment on exhibition. The Rochester Convention [my first] had a lot of the rush and roar of a fraternal or political pow-wow. Some of that may be needed, but enough is too much at a technical meeting that's supposed to be educational.

Who can write a good discussion of projection room ventilation and when will the I. P. or S. M. P. E. give it publication? The worst ventilated theatre here recently closed for rebuilding. That's one way to get rid of some of the "black-hole" projection rooms, but it does put men out of work and there is no assurance that the rebuilt room will be much better.

I. P.'s five years leave you an infant. I've heard of "operators" who have been "thuty yars in tha business" who never read any technical publication, not even I. P. But the most of us appreciate "our best publication" and wish for you many more years of even greater success—still *sans* congratulations.

Frederick J. Closser
L. U. 253, Rochester, N. Y.

Several reports of the Projection Practice Committee of the S. M. P. E. have cited the requisites for acceptable ventilation of projection rooms. As with most other projection recommendations, the problem here is to gain acceptance by architects and by theatre owners. The large circuits are practically the only groups today which give careful consideration to projection room requisites in advance of construction.—Ed.

FILM PRESERVATION DATA

Excerpts from a report by the National Bureau of Standards anent the storage, preservation and handling of motion picture film are appended hereto:

"The films have been studied by using extremes of temperature and moisture conditions as accelerated aging tests, and by putting them through various cycles of temperature and humidity conditions to find the optimum storage conditions. Tendency of the films to become brittle under such treatments has been studied by testing for decrease in folding endurance. Chemical deterioration of the film base has been tested for by finding whether any drop in viscosity of solutions of them, loss in weight, and increase in acidity occurs. In addition, the nitrate films have been tested for time required for acid fumes from the film to discolor a test paper on heating—a test used for gun cotton.

"Film should be stored in air having a relative humidity of about 50 per cent. After they are used in the projection machine, they should be exposed to air of this humidity in such a way that the air has free access to all parts of the film, to restore moisture that may have been lost, and they should not be reused until moisture equilibrium has been obtained. This moisture condition plus a low temperature, not above about 50°F, is suitable for prolonging the life of nitrate films. Such conditions have been recommended by the S. M. P. E. committee on film preservation. The films should be carefully wiped clean before being stored.

"Study of the deterioration of the emulsion of nitrate films showed that the acid gas resulting from the decomposition of the film base is destructive to the emulsion, consequently it is recommended that vented containers be used for this type of film. For the same reason acid-resistant containers are necessary for storage of nitrate film. The acetate film presents no problem in these respects."

The I P EDITORIAL PAGE

Vol. 12, No. 6 DECEMBER 1936

Import of Aperture Temperature

The article by Frank Dudiak relative to aperture temperatures, which appears elsewhere in this issue, provides an interesting contrast to a similar effort by Dr. A. C. Hardy in I. P. for October (p. 24). Many readers will charge that the Dudiak tests have no particular significance, not only because of the physical limitations of the equipment used but also because he draws no conclusions therefrom applicable to the effect of such temperatures upon rapidly-removing film. Such a charge would have more force in the case of Dr. Hardy's tests, however, because he somehow contrived to confine his readings to the *aperture plate*—and the conclusions he advances are less significant than Dudiak's findings because the film does not at any time come into contact with the plate. It would seem appropriate at this point to ask: Just what is the purpose of such tests?

The purpose is, obviously, to ascertain the hazard to human life (the projectionists, if not the audience) and to property inherent in a projection process which utilizes a light source generating such enormous heat. Biased observers always read into such findings an effort on the part of the organized craft to justify the demand for ample manpower. Well, what about it? Noteworthy was the dexterity displayed by producer representatives in rushing Dr. Hardy into the breach, to produce a compilation of figures, when regulatory bodies cold-shouldered the new double reel. Meanwhile the organized craft, with not more than two notable local exceptions, was very busy taking a siesta, so that the producer representatives would have clear sailing toward their objective.

Nitrate film has a flash point of 320° F. Dr. Hardy made much of the fact that, with the film reaching the aperture in a "relatively cool state" and requiring a certain length of time before it was heated, his finding of 201° F as the maximum heat of the aperture plate constituted ample assurance that the quickly-moving film would not ignite. He did find, however, that a temperature of 1000° F existed in the center of the aperture *practically instantaneously* when turning on the arc. *This* is the crux of the whole matter, the only figure that has any practical significance. After all, nobody is concerned with the temperature of the aperture plate, but everybody is vitally interested in the degree of heat to which film, if interrupted, might be subjected.

Dr. Hardy did supply an imposing argument in favor of the double reel; this must be admitted, irrespective of other pertinent factors. Coincidentally, however, and most important, Dr. Hardy supplied but did not dwell upon the best argument ever produced in favor of ample projection room manpower, the most forceful reason for having a man *constantly* at the side of the projector in operation. 1000°F is calculated to gain the respect of any projectionist and his constant attention nearby, not at the rewind bench.

Dudiak deserves commendation for a good job by a practical projectionist who was hampered by the lack of facilities, but who did not lose sight of the essential reason for his work of testing.

Specific Data in all Sound Contracts

Most distributors of sound equipment, in addition to designating their equipments by number, also employ phrases indicative of what they think the equipment will deliver in the way of performance. Thus we have had such colorful phrase-making as "Wide Range," "High Fidelity," "Three Dimensional" (whatever that is), "Fonophonic," and "Mirrophonic," to cite only a few appelations. This is all very nice and sweet, and we should be the last ones to decry this yen for expressive phrases. Of late, however, disturbing reports in steadily increasing number are reaching I. P. to the effect that the sound companies are taking these cute descriptive phrases much, much to seriously, and are selling exhibitors equipment not on the basis of unit numbers or promise of specific technical performance but rather by mere name.

One particular contract that has come to our attention simply states that the sound company will deliver so-and-so "brand" of equipment for so-and-so many dollars. No mention is made of the *kind* of equipment that will be delivered —*i.e.*, type of amplifier, number and type of speakers, type of soundhead, *etc.* In short, the sound companies merely promise to "modernize" existing equipments, the extent of which modernization seemingly is left entirely to the discretion of the seller. But what about the buyer? Didn't he purchase a "modern" equipment just last year? Didn't he have his sound unit "revamped" by the addition of "improved" accessories, such as amplifiers and speakers? And weren't promises forthcoming then that the result of this "improvement" would be clear, bell-like sound from 40 on up to 10,000 cycles?

Well, it certainly appears that the theatres either were rooked then or are being rooked now. Either the exhibitor should ask for a refund of his 1935—yes, and even his 1936—payment or he should insist that his existing equipment be "modernized" without charge. No sound company salesman should be permitted to stick a contract under the nose of an exhibitor and ask for the latter's signature for a "brand name" of equipment. The exhibitor should inquire as to just what this "title" includes; and the salesmen should be compelled to specify by *number* and *type* and *quantity* just what he will deliver for the price asked.

For their part, projectionists should protect the interest of the exhibitor at every step of the way. In detailing new sound equipment, of whatever make, I. P. has always been careful to give explicit information as to just what number, type and quantity of components is to be expected. This information is for the benefit of you, Mr. Projectionist, and through you for your employer. Use it.

If complaints of this character continue to pile up, I. P. will cite *verbatim* some of the sound equipment contracts being offered, and will supply names, facts and figures. Projectionists are at liberty to consult I. P. on any sound equipment purchase and ascertain just what they are entitled to receive in the way of component units.

To its thousands of friends throughout the world I. P. extends its appreciation for continuing loyal support and voices the hope that 1937 *may bring the best of everything that life has to offer.*

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

ERPI practices in the sound equipment field were uncovered recently in the hearings conducted by the Federal Communications Commission in its investigation of A. T. & T., parent body of Erpi. Examination of J. E. Otterson, former Erpi president, developed the following: (1) Otterson's recommendation to his superiors that RCA be purchased, or arrangements made for its dissolution, because the price would be well worth while if Erpi could enjoy "exclusive" rights in the sound picture field, and (2) that Otterson was active in delaying comparative tests between Erpi and RCA equipments, so that the issue of interchangeability might remain unsettled, to Erpi's profit.

F. C. C. counsel introduced wires from Otterson to the Erpi representative at the tests stating that the latter "doubtless will be able to find technical objections to anything they might do," and adding that it was essential to delay "until we have Pathe in the bag." All of which, the F. C. C. charged, was designed to raise in the minds of theatre owners considerable uncertainty as to the quality of RCA equipment, its ability to reproduce Erpi-recorded film, and the ability of the exhibitor to run RCA recordings and still have Erpi retain its responsibility for repair and replacement work on W. E. sets.

The Commission charged that Erpi did nothing to dissipate this impression of RCA equipment inferiority. Otterson replied that Erpi was under no obligation to do so, despite the fact that the Erpi man at the test wired him that he had been "forced" to tell RCA that he had no criticism. The Erpi so-called equality clause was altered in Dec., 1928, until which time, the F. C. C. charges, exhibitors shied away from RCA because they feared being unable to purchase Erpi-recorded features.

It was shown that Erpi's restrictive clauses in both the studio and theatre fields were modified in 1935 only after David Sarnoff, head of RCA, had filed with Erpi a draft of a proposed suit charging unfair tactics by the latter. (These charges were detailed exclusively in I. P. for October, 1935.)

Erpi Servicing Policy

Erpi equipment servicing policy, including repair and replacement charges, also were pried into by the Commission. The investigators sought to show that Erpi's compulsory service charges were unwarranted, with exhibitors forced to pay weekly for service the type and frequency of which was entirely at Erpi's discretion. In 1928 Erpi was servicing 450 theatres; in 1932, it had 5,457, while in 1935 it had only 4,745 theatres on service. Annual gross income of Erpi from servicing from 1928 to 1936, including profit or loss designations, was admitted by Erpi to approximate the following figures:

Year	*Gross*	*Profit*
1928	$950,000	$70,000
1929	3,375,000	125,000
1930	5,500,000	1,100,000
1931	5,000,000	965,000
1932	4,500,000	1,062,000
1935	3,000,000	270,000*
1936†	1,200,000	130,000*

† *Six months.* * *Loss.*

H. M. Wilcox, former operating manager of Erpi, testified that the drop in servicing revenue, as shown above, coincided with the elimination of the compulsory servicing charge. In October, 1934, Wilcox suggested the servicing of competing equipment by Erpi as a means of bolstering its servicing revenue.

Numerous protests by leading exhibitors against the Erpi practice of compelling purchase of Erpi replacement parts exclusively, which was modified in 1932, evoked from Wilcox the statement that "The repair business has always been a headache, and always will be. It is not profitable." The F. C. C. contends that the Erpi contract for parts purchased from W. E. and Bell Telephone Labs. necessitated a high price to theatres. Figures showing Erpi repair and replacement profits are as follows: profits of $60,000 in 1928; $77,000 in 1929, and $89,000 in 1930. Losses of $112,000 in 1931 and of $60,000 in 1932 were recorded. These figures supplement those given previously for servicing.

The Commission released figures showing that at present there are pending 22 anti-trust suits against Erpi, totalling $175,281,675, figured on the usual triple-damage basis of such actions.

Probably the most damaging bit of testimony unearthed by the Commission was a letter from Otterson which advised that a proposed agreement relative to sound licenses be submitted to Sidney Kent, Paramount head, as coming from one Louis A. Schwartz, a Paramount lawyer who at that time was one of two representatives of the producers in negotiating with Erpi.

DeMille Lauds H. Rubin's Projection Work

Harry Rubin, director of projection for Paramount Pictures Corp., was tendered a testimonial dinner recently in N. Y. City on the occasion of his 25th anniversary on Broadway. Among the guests was Cecil B. DeMille, in N. Y. for the premiere of his new picture, "The Plainsman," who payed glowing tribute to Rubin for his projection accomplishments, discussed generally the great importance of projection to the industry, and wound up by saying that he had never failed to confer with Rubin regarding the quality of his big-picture prints before they were released.

M-G-M's Four-Reel "Shorts"

In an effort to curb the continually increasing use of double-feature bills, M-G-M plans to use some of its feature talent to produce a series of 4-reel "shorts," the contention being that the current dearth of quality shorts encourages the use of double bills.

RCA Channels Installed

Installation of RCA ultra-violet recording channels has been completed at the Warner, Columbia and 20th Century-Fox studios, reports RCA. Installations of High Fidelity theatre equipment have been double the rate of last year, it is asserted. First equipments from the new Indianapolis plant will be ready by Jan. 1, augmenting that produced by the main RCA plant in Camden.

Dr. Lee de Forest Bankrupt

Listing liabilities of $103,943 and exempt assets of $390, Dr. Lee de Forest, inventor, has filed a voluntary bankruptcy petition in Federal Court at Los Angeles, Calif.

Stong Advanced at Erpi

C. L. Stong has been named sales promotion manager of Erpi, heading a new department in that company. Move anticipates a more solid bonding between field sale force and home office personnel. Stong has been active with engineering division of W. E., notably with the Erpi field organization in Hollywood, Pittsburgh, and Detroit as division superintendent.

Chicago Musicians Ban All Recordings by Members

Chicago Federation of Musicians has banned all members under its jurisdiction from making discs of any kind, the theory being that this practice results in too much "canned" music being distributed, through ether or wires, with resultant loss of employment oppor-

tunities. Order, effective Feb. 1 next, will apply to all types of recordings, including pop records, radio discs, library recordings, and film and synchronization recordings. Certain exceptions to be made will be okayed by executive board of union. Sound picture recordings and one-time disc jobs are exempt, providing latter are promptly junked after one shot.

Union is reported incensed at various radio stations using discs over and over, to the exclusion of flesh orchestras. Also is burned at use of discs by the many new wire services which pipe music into taverns, bars, restaurants, etc. Chicago outfit all alone in this move so far, although hoping for "cooperation" by other AFM units throughout the country.

Use of non-sync discs by theatres as recessionals and between programs reported to be a prime source of concern to Chicago musician's union.

N. Y. Masonic Group Active

Projectionist Square Club, composed of projectionist Masonic members in N. Y. area, will sponsor a dinner-dance at Edison Hotel, N. Y., on Jan. 24. Members recently obligated themselves to furnish maintenance and parts for sound equipment at Masonic Home in Utica, N. Y. Otto Kafka, member of Club, has just completed a tour of N. Y. state with a 4-reel history of development of the Utica Home.

Bonus for Union Employees

Union employees were included in the Christmas bonuses distributed by the Jones, Linick & Schaefer theatre circuit in Chicago. First time for union help of J. L. & S., and one of the rare occasions anywhere.

Polaroid for Stage Sets?

The Radio City Music Hall in N. Y. City, world's largest theatre, is playing with idea to utilize Polaroid as covering for all stage sets, curtains, drops, etc. Enormous area of Hall stage causing no little concern as to cost. N. Y. Museum of Science and Industry, also berthed in Radio City, now has on display small model stage showing the brilliant results obtainable with scenery of Polaroid composition.

For the B. A.'s Scrapbook

Samuel Briskin, RKO production chief, in discussing stock options that will be offered to company executives, opined that a profit participation was sound business logic, because no matter how sincere, honest and interested in his work a person was, profit-sharing was a greater incentive.

Foregoing thought is recommended as excellent material for the business agent's scrapbook.

Enjoin Television Stock Sale

Television Corp. of America has been enjoined from the further sale of securities in N. Y. State. Order, signed by N. Y. Supreme Court, requires defendants to show cause why the injunction should not be continued pending the final determination of the action and why a receiver should not be appointed for the concern. Company is a Maryland corporation capitalized at 6,000,000 shares of $1 par value each.



I. A. Units Jump 16 mm. Auto Shows Throughout Country

Automobile shows provided I. A. units with opportunity to effect opening wedge in 16 mm. industrial trade-showing field. Started with the auto show in New York, when L. U. 306 insisted that union men be employed during trade showings of industrial films by Chrysler in the corporation's little theatre on West 42nd Street.

Though arrangements had been made to employ customary (non-union) 16 mm. projectionists, Chrysler did not hesitate in placing union men in the little 250-seater because of no desire to have picketing while automotive exposition was in progress. Chrysler spent about $300.000 making this an ideal spot for showing industrial 16 mm. films to salesmen and visitors.

This situation was duplicated in Chicago when a large motor car company desired to show 16 mm. industrial subjects. Full union crew was installed, as in N. Y.

Projection Room Fire Precautions

It has been well said that people need not so much to be told as to be reminded. The recent series of projection room fires, with their accompanying toll in human lives and great property damage, calls for a restatement of those fundamental precautions against fire, known to all projectionists but so easily forgotten.

All safety features of the projector must receive frequent and thorough inspection to determine their ability to function as intended.

Automatic fire-shutter tracks must be kept clean.

Correct tensions must be maintained on the upper reel spindle, film tension shoes, intermittent sprocket pad, and take-up spindle.

Correct clearances must be maintained on all pad (idler) rollers, film gate apron and fire-valve rollers.

All film strippers must be set up tightly in proper adjustment.

Pad rollers, lateral guide rollers and fire-valve rollers must be properly lubricated and adjusted to permit of their being kept in motion by the film in transit through the projector thus preventing the film from wearing flat sides or cutting grooves in the rollers. Grooved lateral guide rollers, flat sided fire-valve rollers, flat-sided pad rollers and undercut sprockets must be re-placed.

Mechanism and magazine doors must be kept closed during projection and must also be provided with latches, properly adjusted, to prevent accidental opening.

Each projector should be equipped with an aperture heat-shield, an eye-shield which encloses the light beam, a rear shutter and a dowser between the light source and the aperture. (Compared with the front shutter type, there is a reduction in heat at the aperture of at least 50% when rear shutter is used).

Lamp-houses must be equipped with a fine screen in bottom to prevent hot carbon chips from falling out, or anywhere where there is a chance to drop out.

Be certain fire-shutter is closed before adjusting light beam on aperture.

A frequent and periodic check-up on the operation of the port shutters must be made.

Large shutters should be counterweighted. All shutters should have rubber bumpers installed in sill so, in the event of fire, there will be no noise to alarm the audience. All shutters shall have individual fusible links. All shutters shall be connected to a master release cord which shall contain a fusible link located directly over each item of projection equipment. Means for manually operating shutter release cord shall be provided at the projectors and also near the projection room exists.

Ports for spot-lights, stereopticon and effect-projectors shall be kept closed except when in actual use. Projection room exit doors must be kept closed while audience is in the theatre.

(To Be Continued)

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H. C. 10 Super Intensity Lamp

FIRE PREVENTION IN THE M. P. INDUSTRY

(*Continued from page* 16)

or connected by piping to fixed outlets. It depends for its effectiveness upon displacing or diluting the air that would otherwise support combustion, thus smothering the fire. It is suitable for use upon ordinary combustible materials and inflammable liquids and for marine use. Fixed installations are made for use in confined spaces. Small rooms or compartments may be filled with the carbon dioxide gas, thus cutting off the oxygen supply. Some consideration must be given to the possible ill effects of the gas, inasmuch as carbon dioxide will not support life. To detect leakage the extinguishers should be tested by weighing at least annually.

Precautions Against Carb. Tet.

Carbon Tetrachloride.—These are the familiar hand-pump type, and are particularly adapted for electrical fires, as the liquid is non-conducting. They are suitable in certain special cases for use upon burning oils, but are not recommended for general use. In confined or unventilated spaces, precautions should be taken to avoid breathing the gases and vapors liberated when they are used on fires. The gases are also corrosive, which is of importance in connection with delicate electrical apparatus. The extinguishers should be tested at least annually by partly discharging and refilling.

Dry Chemical.—These employ an inert gas to discharge a dry chemical in powdered form through a hose. They are effective in oil fires, and may be used about electrical apparatus.

Pails of Sand Useless

There are on the market a great number of other miscellaneous fire fighting devices, such as glass bombs, bottles filled with various liquids, and tin cans filled with sand or powder, comparatively few of which have any real value except in special cases. Sand pails are often prescribed for projection rooms by local fire departments. There would appear to be no possible conditions under which they might be effective in room fires.

One important guide in the selection of the extinguisher is the label of the Underwriters' Laboratories, which is assurance that the device is reliable; but the mere labeling does not mean that the extinguisher may be used indiscriminately for every kind of fire. Each extinguisher must be selected for the purpose for which it is intended.

Recently some success has been had in controlling and extinguishing oil fires by means of a special spray nozzle, developed in England, using water at high



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For perfect rewinding on 2000-foot reels.

CLAYTON PRODUCTS CO.
31-45 Tibbett Avenue New York, N. Y.

pressure. The nozzle is so designed that it breaks up the stream of water into a very fine spray, which is ejected at high velocity. It is possible that further developments in the use of high-pressure sprays may be of value and importance to the motion picture industry. Water applied to fire under such conditions seems to be considerably more effective than when thrown from a sprinkler system, hose, or extinguisher.

Such a spray has a great cooling effect. The fine spray cools the surrounding atmosphere, and is most effective in preventing the spread of fire. It has also the property of washing out obnoxious fumes and gases given off by burning or decomposing nitrocellulose film or other material. One of the large sprinkler companies made some tests for the writer with these spray nozzles on burning film, and, as a result, it was felt that they merited further consideration and study. With the spray in operation, a reel of motion picture film reasonably isolated can be completely consumed by fire with little, if any, possibility that the fire will be communicated to nearby film or equipment, with the fumes reduced to a minimum and with the temperature of the room kept at a normal degree.

Fighting Oil Fires

Burning oils afford a somewhat difficult problem. We do not have much success in extinguishing oil fires with water. Unfortunately, oil is lighter than water, and water from hose streams or sprinkler systems used on oil sinks to the bottom and may cause the oil to rise and overflow. The spray method, however, depends for its effectiveness upon the fine globules of water penetrating the oil for a short distance and forming an emulsion of oil and water at the surface of the oil. This emulsion contains a sufficiently high percentage of moisture to be non-combustible, and there is thus formed a non-combustible blanket over the surface of the liquid. In addition, the water has a cooling effect, and the stream produced excludes oxygen.

An automatic sprinkler system is the best all-around fire fighting device. Automatic sprinklers have behind them a record of many years of effectiveness in fires of all kinds. Studios, laboratories, vaults, exchanges, and all rooms wherein film is handled and stored should be equipped with automatic sprinklers. The hazard to life is practically eliminated in sprinkled buildings. *The spray from sprinklers has a great cooling effect, and washes out smoke and obnoxious gases given off by the burning materials.* The requirements for maintenance are highly technical and space does not permit covering them here.

Persons should not be subjected to the fumes of burning film unless equipped with a mask. It may be interesting to know that until recently no tests had been made to determine the effectiveness of the canister type of mask in film fires. The U. S. Bureau of Mines has, however, made such tests, and has found that the Burrell-All-Service mask is safe for such use. The oxygen helmet is also effective, but is cumbersome to use.

Several pairs of asbestos gloves are kept near the sound equipment, to be used for beating out small fires or handling hot wiring or other parts at time of fire. We have experimented with various fire extinguishers, and after considering all factors have adopted the carbon dioxide type. This type discharges a large volume of carbon dioxide gas at extremely low temperature. Carbon dioxide will not sustain combustion and, therefore, serves to blanket the fire out. Distilled water in a pump type of extinguisher, or an extinguisher using a cartridge filled with gas at high pressure, may be used as a second line of defense.

However, prevention of fires is far better than extinguishing them, and engineers engaged in the design, construction, and maintenance of sound equipment should give the utmost consideration to prevention of fire. Non-combustible materials and insulation should be selected whenever it is within reason to do so. Capacity of conductors should be adequate. Avoid too large values in any one unit. Design should call for segregation in rooms of fire-resistive construction, divided into comparatively small sections and equipped with every modern fire-detecting and fire-extinguishing device. The room should also be waterproofed not only against leakage but against rising water.

Fire protection is a special art and it is asking too much to expect the motion

picture engineers to be thoroughly informed or to keep abreast of new developments in it. The advice of well-qualified and informed fire prevention engineers should be sought before the design is commenced, and contact should be maintained throughout.

Fire Prevention in Theatres

In the motion picture theatre, safety to life is of first importance. Wherever persons congregate in large numbers there is always present the possibility of loss of life, often from even the most inconsequential causes. Fire is one of these causes, and one of the most dreaded. In well-operated theatres, fire protection and fire prevention are given the consideration they deserve. Daily inspections are made. Adequate exit facilities are provided. The stage is provided with an asbestos curtain, stage skylight, and automatic sprinkler system. The projection room is of fire-resistive construction, parts are provided with automatic shutters, and doors are self-closing. Adequate mechanical ventilation is provided. Fire-resistive film cabinets are installed.

The theatres operated by the industry are today confronted with rapidly rising costs of public liability insurance. In some instances rates have increased ten times or more during the past two or three years. This is partly due to the racketeering type of claim and to increasing claim consciousness; but on the other hand, a great many claims arise from actual physical defects in the theatre and from improper operation of the theatre. The balcony, particularly, with its irregular stairways and generally inadequate lighting, both overhead and at specific points, contributes to a large percentage of the accidents.

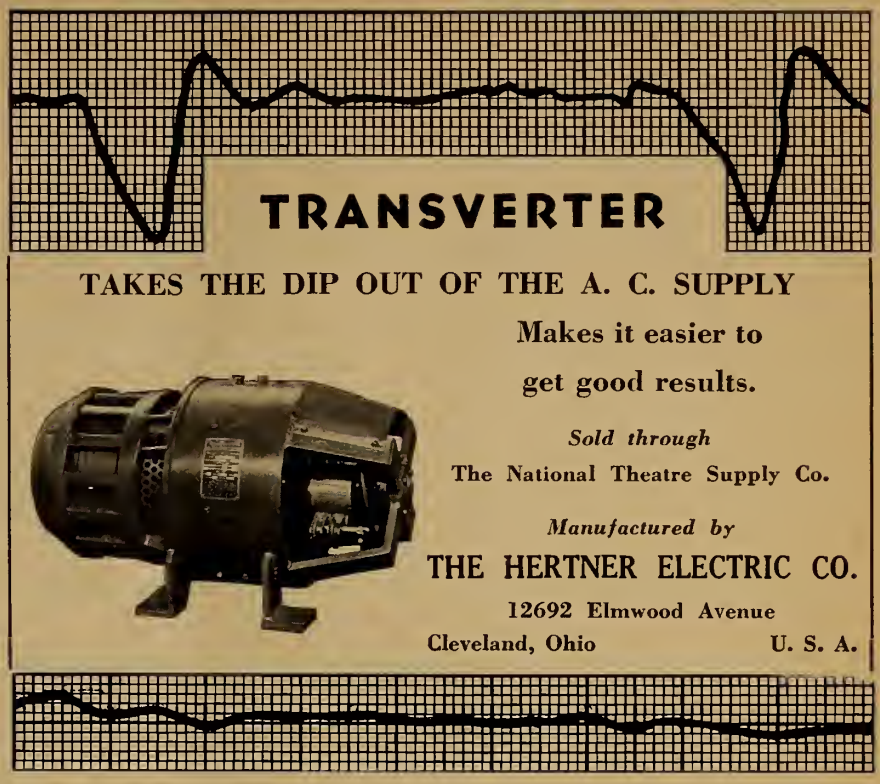
The average aisle light, as constructed and installed, is practically useless. It throws a concentrated light upon the single spot, and makes the general condition worse rather than better. There is need for an adjustable type of aisle light that will throw a diffused light and generally illuminate the aisle or steps.

In general, the overhead illumination in motion picture theatres is insufficient from a safety standpoint. There is a field for the engineers, to design overhead and special illumination that will not throw light upon the screen or glare in the patrons' eyes, but will nevertheless provide safe illumination for seating and passage of patrons. It might be possible to establish the minimum degree of illumination at the floor level adequate for safety of the patrons.

The S. M. P. E. can perform an important service in the prevention of fire in projection rooms, and in preventing damage if such fires occur. One way in which to accomplish this is to improve the machines and equipment constantly, with the object of making them safer. Sound equipment should be enclosed and so installed as to be unlikely to be damaged by a trifling fire or by smoke or water.

Although the Fire Underwriters have issued regulations covering the construction of projection rooms, and they and various city authorities have made regulations covering the installation of extinguishers, no one has yet covered the subject of just how a fire in a projection room should be handled. If the S. M. P. E. could formulate such a code, it would be of great value and assistance to the industry. Likewise, a code is needed regarding the procedure of fighting fires in sound equipment. The subject is certainly important enough, and recommendations made by the S. M. P. E. would carry much greater prestige than those originating outside the industry.

The Society constitutes, in certain technical problems, the one best contact between the motion picture industry and outside associations engaged in fire protection work. There is a great opportunity for important constructive work in this field.



ANNOUNCEMENT

After January 1st our offices and showroom will be located at

250 EAST 43rd STREET, NEW YORK

New telephone number MUrray Hill 4-1636

FISH-SCHURMAN CORPORATION

NOTES *from the* SUPPLY FIELD

★

NEW SUPREX GENERATOR READIED BY ESCO

A new motor generator for use with Suprex arcs has been designed by and is now available from Electric Specialty Co., of Stamford, Conn. These machines have been designed so that two projectors may be operated from the same motor-generator during the change-over period without affecting the picture illumination.

The Suprex arc will operate satisfactorily with much less ballast resistance than the standard arcs. Some ballast resistance is necessary, however, to prevent destroying the crater when striking the arc. These Esco motor generators are designed for satisfactory operation, but at the same time the ballast resistance is low enough to insure great savings in the power bills.

NEUMADE PRODUCTS NOW IN ITS NEW HOME

Neumade Products Corp., makers and distributors of a wide line of projection accessories, is now located in its new and larger quarters at 427 West 42nd St., New York City. Oscar F. Neu, president of Neumade, extends through I. P. a cordial invitation to projectionist visitors to New York to drop in and inspect the latest appliances.

WESTINGHOUSE LAMP CUT

Westinghouse has reduced the price of its complete line of motion picture projection incandescent lamps, effective immediately. The reductions will average about 10% on all sizes of lamps. The increasing use of home movies, resulting in production economies, is cited as the reason for the slash in prices. G. E. announced a similar reduction a short time ago.

FISH-SCHURMAN NEW HOME

Fish-Schurman Corp., distributors of optical, scientific and technical glass and porcelain, have moved their offices and showrooms to larger quarters at 250 East 43rd St., New York City. A testing and control laboratory has been installed for the convenience of their customers. Fish-Schurman are the American agents for the Jena Glass Works, of Germany.

ANDRE DEBRIE TAKES RCA PRINTER LICENSE

Andre Debrie, Inc., manufacturer of studio and laboratory processing equipment, has been licensed under RCA patents to manufacture and sell a new non-slip printer for film processing based on technical developments of the RCA laboratories. Other equipment manufacturers also are negotiating for similar licenses.

The non-slip printer automatically compensates for differences caused by shrinkage of the processed negative and positive film printed from it. RCA points out that with ordinary printers, minute variations between print and negative at the point of printing blurs the photographic registration.

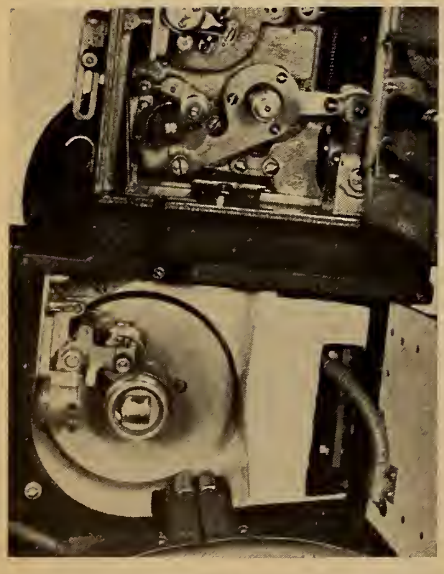
AEROVOX ISSUES CATALOG

An enlarged and considerably revised catalog has been issued by Aerovox Corp., 70 Washington St., Brooklyn, N. Y. It covers a most extensive line of condensers and resistors for radio and allied applications. The outstanding feature is an entire section devoted to exact duplicate replacement condensers, listing standard sets and their condenser replacements, in order that the serviceman can secure replacements precisely matching original equipment. Many new condensers are announced for the first time. Extensive price reductions reflect the popularity of certain standard items. A copy of the catalog may be obtained by writing the company direct.

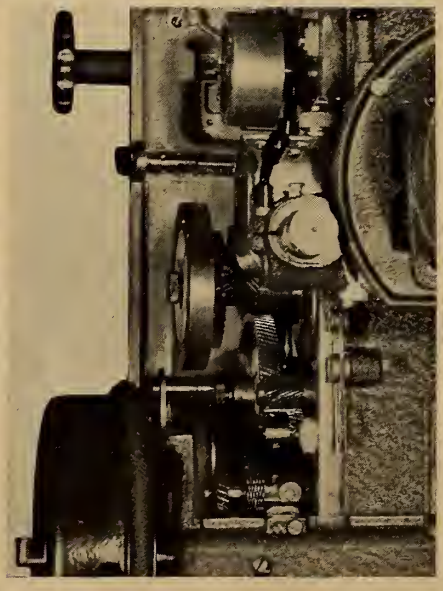
DAWSON JOINS DETROIT N. T. S.

W. P. Dawson, member of I. A. Local 199, has been added to the Detroit sales staff of National Theatre Supply Co. Dawson has been with the equipment supply business, on either full or part time, for the past 15 years. He will devote all of his time to his new duties.

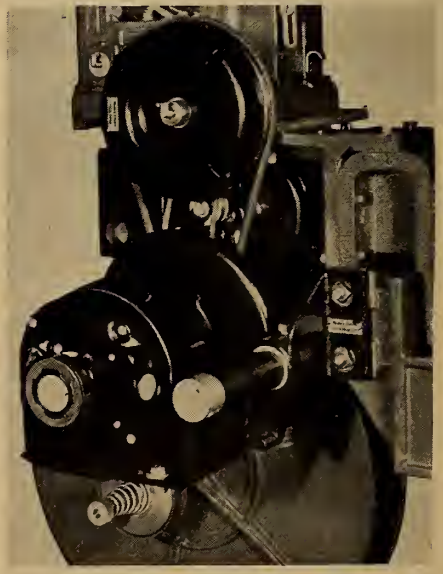
Motiograph Model K Adapted to W. E. 211 Sound Head



On the milled surface of the crankshaft bearing, a bracket has been installed which carries the idler and film chute necessary for guiding the film to the sound unit. The path of film travel through the projector and thence to the W. E. 211 sound head is clearly shown in this photo. The accompanying photos refer to changes on the drive side.



New reversing gear has been added in order to operate take-up sprocket in a reverse direction from that customary on all previous models. This was necessary because the mechanism was doing the entire work of feeding the film through the sound head, pulling it over the Erpi "kinetic scanner," and then feeding into lower magazine.



Adapter extension plates were necessary to advance the motor-drive unit to line up perfectly with mechanism-drive unit on Model K base. This brings the "T" slot forward where the regular motor attachment fits. Made necessary on Model K base because the "T" slot iron sets a bit back of the measurements of the standard Simplex "T" slot motor table support casting.

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Mr. Fine Says . . .

I am more than satisfied with Simplex Acme TRADE MARK REG. SOUND PROJECTORS

MT. PLEASANT THEATRE
3685 EAST 131st STREET
Cleveland, O.

November 3, 1936

National Theatre Supply Co.
2112 Payne Avenue
Cleveland, Ohio

Gentlemen:

I am writing this letter to expres my feelings regerding the instslletion of your new Simplex Acme sound projectors, with your new amplifier system.

This is the first time since this theetre was built, thet I have actuelly hed persons come up to me and tell me how wonderful the sound is, and how well lighted the picture is. I too, must say, that I am more than setisfied, end thet this equipment has performed better than any equipment I have evet owned. It is indeed, very hard to find words to eey how thankful I am that I purchased this equipment.

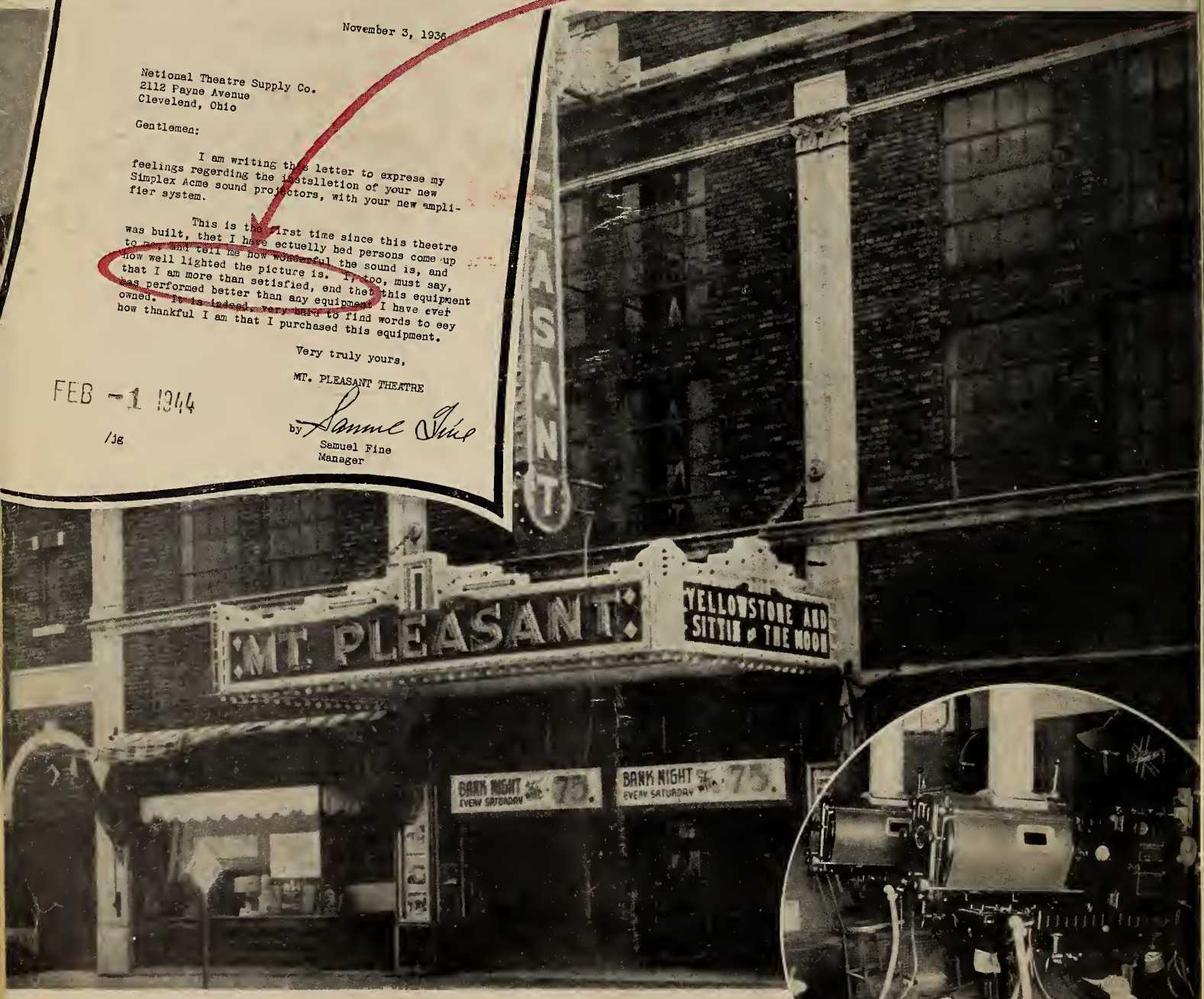
Very truly yours,

MT. PLEASANT THEATRE

by Samuel Fine
Samuel Fine
Manager

FEB -1 1934

/jg



PROJECTION ROOM

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